



US Army Corps  
of Engineers®

# Engineer Update

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## Public to speak, Corps will listen

Article by Becki Dobyns  
Photo by F.T. Eyre  
Headquarters

It is vital for any organization to listen to its customers. The U.S. Army Corps of Engineers has done this for years but, during the next several months, we're going to do it in a new way. From Anchorage to Atlanta, citizens and organizations interested in the nation's water resources will have an opportunity to speak out on water-related issues in a series of public workshops with the Corps. Civil works professionals throughout the Corps will meet with stakeholders and the public to listen to their views about the nation's water challenges. They will also examine the federal government's role in addressing them.

For the "Join the Dialogue" listening sessions, the role of stakeholders and the public is to dialogue while the Corps' role is to *listen*. The sessions are meant to be the first step in examining pressing national needs. Aging water resources infrastructure, for instance, is one of six preliminary challenges identified by the Corps.

"When you consider that many of our projects are far beyond their design lives and that the nation is faced with a steadily-growing population, we believe the nation's water infrastructure is fast approaching a time when it will be inadequate," said Maj. Gen. Hans Van Winkle, Deputy Commanding General for Civil Works. "If these needs remain unmet, we believe the impact will harm our nation's prosperity and well-being. On this premise, we want to stimulate a dialogue, and learn what the interested public has to say. Are they seeing what we see? What are the pressing needs from their perspectives?"

Each Corps division will sponsor at least one listening session (but likely two sessions) for a total of 14 nationally, spread out geographically. The first session will be in St. Louis, Mo. on June 16. The final meeting will be in Vancouver, Wash., in September. Stakeholders from federal, state, local and tribal governments are invited, along with environmentalists and those with economic interests. The public and the media are included as well. Those who cannot attend one of the listening sessions may contribute their views on-line, participate in an on-line discussion, or call a toll-free number (see final paragraph for details).

Van Winkle is quick to point out that



Upgrading the nation's aging water infrastructure to accommodate the population of 2020 will cost \$325 billion. Above, Nicolas Young enjoys a drink at the Mount Vernon Recreation Center.

the listening sessions are intended to help us better understand what the public thinks about water resources needs and issues.

"Our role here, as spelled out in Vice President [Al] Gore's 'Conversations With America' initiative, is simply to listen to those we serve and find out what's important to them," said Van Winkle. "But the purpose here is to listen respectfully and not suggest solutions or push an agenda. I think a pleasant side effect of this could be that we learn to listen more extensively as part of our corporate culture. This could serve as a model to further a listening practice throughout the Corps."

Van Winkle is especially interested in clarifying the role of the federal government in water resources development, management, and integration.

"So many levels and organizations are involved in the water resources business that it is imperative to involve the federal government — and the taxpayers' dollars — in areas where it's most appropriate and where we can have the greatest impact," Van Winkle said. "Because water crosses jurisdictional boundaries and touches all citizens' lives in so many ways, the federal government has a major role to play. But as states gain competency in water resources management, the

boundaries of our respective roles can blur. So we want to talk about general needs for which federal government involvement is appropriate. What's important is that the proper federal role gets identified, not which agency gets the mission."

To encourage maximum participation from all attendees, the listening session will employ a facilitated workshop format.

"We have a lot of ground to cover in a limited time, so we're using a professional facilitator," said Mark Gmitro, who is managing "Join the Dialogue" from the Institute for Water Resources. "But while we'll use a facilitated discussion format, we'll allow people to post written statements for the record and for all to read. Statements will be accepted before, during, and after each session and will be posted on the web site. The sessions' design includes large- and small-group discussions, along with the opportunity to discuss both national and focused challenges."

Gmitro said that, while the Corps will rely on its vast experience in public involvement, the listening sessions are somewhat different from most Corps public meetings.

"The 'Join the Dialogue' sessions are an attempt to canvass a wide set of water resources issues, not to probe

particular projects," Gmitro said. "We want a more expansive dialogue. We are not intending to focus on site-specific problems, but to identify the challenges facing the nation."

Information from all the sessions will be used to:

- Refine the national water resources challenges facing the nation.
- Educate the public and Corps customers about those challenges.
- Revise the Corps' civil works strategic goals.
- Identify gaps that require more attention.
- Develop a report summarizing national water resources needs.

Van Winkle sees two challenges for the Corps professionals conducting the sessions. One is refraining from problem-solving on the spot or advocating solutions. The other is getting people interested enough to attend — communicating the urgency of the issues surrounding water resources challenges.

Van Winkle is less concerned about the recent negative coverage in the national media. He notes that part of the Corps' strategic planning responsibility under the Government Performance and Results Act of 1993 is to solicit feedback from stakeholders about goals and objectives. In other words, we're doing exactly what we've been directed to do.

"All federal agencies have a responsibility to touch base with their customers and stakeholders to ensure wise use of public funds," Van Winkle said. "We have chosen to engage our customers in a dialogue. This exchange has a likelier chance of moving toward consensus about the needs, problems, opportunities, and solutions best suited to addressing water resources issues. The issues cut across so many agencies, government levels, and constituencies, that this kind of public forum may give the taxpayer — and the Corps — the biggest bang for the investment."

The Corps has identified six potential national issues and plans to use these as a starting point for discussion and feedback:

- Our nation's water highway system may not be ready for 21<sup>st</sup> century trade demands.
- Flooding continues to threaten communities, some of them among the poorest in the nation.
- Our environment has been degraded from past development without a sustainable development ethic.

Continued on next page

## Insights

# Chaplain's program grows with baby steps

By Lt. Col. (P) Tim Carlson  
Chaplain, U.S. Army Corps of Engineers

There's a piece of folk wisdom that's been repeated for so long, by so many people, that its origins are probably lost in the distant mist of history — "Before you can run you first have to walk, and before you can walk, you first have to take baby steps."

The concept of baby steps occurred to me numerous times during my past 19 months with the Corps. We've taken lots of baby steps in that time, and even a few strides. In June, I will be reassigned to the Pentagon working with the Chief of Chaplain's Office in the Ministry Initiatives Department. I will mentor chaplain candidates planning a career in the Army. In this, my last "Insights" column, I would like to offer a current snapshot of the Corps' chaplaincy, looking back and then into the near future.

The fourth of November 1998 marked the date of my assignment as the Corps' first-ever chaplain. The immediate mission of my office was to establish a sense of belonging and to address the perceived need in the Corps for a chaplain. Not long after my arrival, the Corps had quite a few persons with serious illnesses, and a higher-than-normal number of deaths and accidents. My mission involved hospital visits, letters of condolence, and counseling sessions with staff members affected by the loss of a co-worker.

My position here was initially provisional. A Unit Ministry Team was not embedded within our force structure. Significant work with the manpower folks in Resource Management and with the Chief of Chaplain's Office resulted in creating one chaplain colonel position and one sergeant first class chaplain assistant position. These were reflected in the Jan.-Mar. 2000 MOC (projected military planning document) window and should become integral to our force structure by October 2001. This, for the first time, will herald true belonging for a Unit Ministry Team.

Getting to know the Corps was another mission. A trip with Command Sgt. Maj. Lugo to Korea and Hawaii began this effort. The Corps is large and the task of visiting all of its members worldwide is an

impossible one. Besides Hawaii and Korea, I've visited Corps dams in Kansas and Massachusetts, and plans for the new chaplain to visit Bosnia and Korea have been considered and could take place this year.

Developing a communication medium through which to positively impact the Corps came early. Col. Bob Mirelson, then the Public Affairs Officer, invited me to begin a monthly column in the *Engineer Update*. That column transitioned from the "Chaplain's Corner" to "Insights." This has been a great opportunity and a pleasurable challenge. I have enjoyed the experience and am most thankful for this duty.

*(Editor's note: Chaplain Carlson's column won a first place in the Corps' annual journalism contest, the Herbert A. Kassner Print Journalism Competition, and a third place in the Army's Keith L. Ware Print Journalism Competition.)*

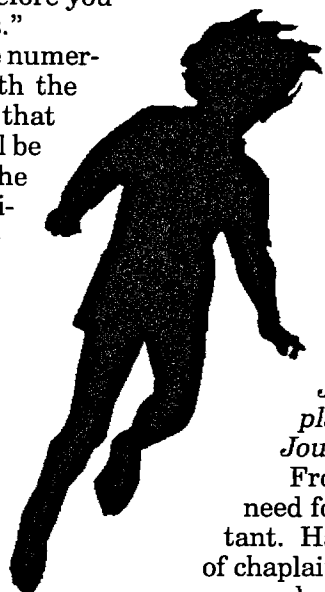
From the very beginning there has been a need for a prayer room and a chaplain assistant. Having an assistant expands the ability of chaplains to meet the religious needs of their commands. The imminent move of Corps Headquarters to the General Accounting Office Building has projected space for a prayer room and a room for a chaplain assistant. The prayer room will give daily opportunity for Corps members to obtain religious and morale enhancement literature, pray, speak informally, or receive counseling formally from the chaplain.

In the 1980s Division 86 was a concept of the future Army. One of its aspects involved something called a "lodgment" — often a combination of an airfield and a space for part of a division implanted near or behind the enemy's lines. My brief stay here has been a sort of lodgment. I feel as if I've landed, engaged in a few of the early battles, accomplished a few of the desired objectives, and now I'm scheduled to move to another place of duty.

I see my time here as an investment and time well spent. I've been honored by the opportunity to be part of a unique organization within the United States Army. I will continue to cherish the invita-

identifying other challenges," Van Winkle said. "If we are off-base, we want to know that now — not after we publish a strategic plan."

Workshop results will be posted on the web site [www.wrsc.usace.army.mil/iwr/waterchallenges/](http://www.wrsc.usace.army.mil/iwr/waterchallenges/) a few weeks after each session. Those who do not have access to the Internet can request a mailed copy by calling the toll-free number (877) 447-6342. People will be able to mail or e-mail comments and opinions at any time. They will also be able to enter into an Internet discussion group to continue the dialogue.



## Listening

Continued from previous page

- Many communities lack adequate water and sewer systems necessary for future public health requirements.
- America's water resources infrastructure may not be able to support future generations because it is in disrepair or under-performing.
- Our nation's capability to respond to natural disasters is being stretched.

"We are using our six identified challenges as a starting point for discussion and are very open to

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## Litter hurts environment

Lt. Gen. Ballard's Earth Day message in the April *Engineer Update* points out that every day should be "consider the environment" day. Whenever we abuse our surroundings (and we do every day), by discarding unwanted trash out of our vehicles onto somebody's property be it roadside, private, commercial, or government, we are destroying the environment through lack of care. Everyone sees cluttered byways. A thoughtless attitude is today's mindset and it is discouraging that we carelessly discard fast-food, cigarettes, glass, metal, rubber tires, car parts, automobiles, furniture, and everything else you can think of to hurt and damage our environment.

My wife Marge and I periodically pick up these things on our half-mile stretch of Cedar Road, and consider doing the same on other streets in the community, because we care. We try to do it near a holiday for our pride. Whatever happened to pride? In today's world it is nonexistent, and it hurts us all.

Bill McCoomb  
Corps retiree  
North Hampton, N.H.

tion of Lt. Gen. Joe Ballard to be a part of the Corps team. I will treasure the experiences and the level of exposure to duty that this assignment has afforded.

The most significant memory that will accompany our family will be the many people whose lives have intersected ours in the Washington, D.C., area and throughout our organization. I've gained an appreciation for engineers and all those who comprise our engineer family. The incisive thinking and unparalleled commitment to duty, demonstrated daily by our organization's members, are equal to that of any organization within the Department of Defense.

In particular, I value the desire of our Chief of Engineers to meet the religious needs of his people. His acceptance of a prayer for the Corps was a highlight for me. Such an element within a regiment is an invaluable component of faith and a true reflection of dependence upon God Almighty. Such humility, in my mind, will define strength for the future as nothing else.

Chaplain (Col.) Lowell Moore and a chaplain assistant, yet to be named, will be assigned in June to continue the work that has begun. I predict that their tenure, in this slice of our nation's Army, will be the most significant one of their entire military journey.

Finally, I thank all of you for your support and acceptance of our family into this engineer family. From my tradition I extend this blessing — "May the Lord direct your hearts into the love of God and into the patient waiting for Christ!" Amen.

### Essays!

*(The views expressed in this article are those of the author and do not reflect the official policy or position of the U.S. Army Corps of Engineers, the Department of the Army, the Department of Defense, or the U.S. Government.)*





## Engineer Day Message

# Corps celebrates 225th anniversary

This is not just an Engineer Day celebration; it is a historic occasion – the 225<sup>th</sup> anniversary of the U.S. Army Corps of Engineers.

The United States has seldom been without Army engineers. We were there at the birth of our nation. From the fortifications at Bunker Hill on June 16, 1775, to the taking of Redoubt Ten at Yorktown on Oct. 14, 1781, Army engineers played a crucial role in the war fought to make the United States a free and independent nation.

Since then, throughout our history, the Corps has earned a reputation for nation-building and national defense. One of our earliest missions was building and repairing fortifications, first in Norfolk, Va., and then in New Orleans. Today, we continue this tradition by building facilities for the Army and the Air Force throughout the world. In the past year the Corps built the Chemical Defense Training Facility and the Military Police School at Fort Leonard Wood, Mo., new barracks and maintenance facilities at Fort Gordon, Ga., a new recruiting station in Times Square in New York city, and a new Medical Dental Clinic at Kadena Air Base on Okinawa.

The Corps of Engineers has always been a scientific organization, at the cutting edge of new technology. In 1825, Maj. Stephen Long calculated the length and angle of wing dams needed to prevent sandbar formation on the Ohio River. Steam-powered snag-boats designed by Henry Shreve dramatically improved navigation on the nation's rivers. Stephen Long developed a new design for railroad

bridges in the mid-1830s. The Corps continued its innovation by fielding the TeleEngineering system that uses satellite communication to allow people in the field to participate in real-time video consultations with anyone in the Corps. Engineers in Albania used TeleEngineering to solve complex engineering problems by communicating with experts at Europe District, Headquarters, and North Atlantic Division.

The Corps has had a flood control mission ever since the 1928 Flood Control Act, which approved dispersing flood waters in the lower Mississippi River through controlled outlets and floodways, and the 1936 Flood Control Act, which declared that flood control is an activity of the federal government and put the Corps in the reservoir construction business. In January, the Corps dedicated Seven Oaks Dam in California, part of the Santa Ana River Mainstem Project, which will protect three million people, and 225,000 structures in the Los Angeles area.

Our first formal disaster relief mission took place during the Mississippi River Flood of 1882 when the Corps supported the Quartermaster Corps in rescuing people and property. The Corps wrote a new chapter in this mission during Hurricane Floyd. In Florida, the Corps purchased and distributed 300,000 pounds of ice, sent two Deployable Tactical Operations Centers into action, and seven soldiers from the 249<sup>th</sup> Engineer Battalion (Prime Power) prepped 280 prepositioned generators for the Federal Emergency Management Agency. In the Carolinas, the

Corps distributed thousands of sandbags to stem flooding, provided 750,000 gallons of water and 960,000 pounds of ice, and stored flood run-off so it could be released in a controlled manner.

The Corps role in protecting water resources has evolved since the 1880s and 1890s when Congress directed the Corps to prevent dumping in harbors. Not long ago, a team in Jacksonville District continued that tradition as they wrote the Central and Southern Florida Comprehensive Review Study, a plan to restore natural waterflow to the Everglades.

Our support for others dates back to the early 19<sup>th</sup> century when the Corps built many projects for the Department of Treasury, including three customs houses, several hospitals for merchant seamen, and dozens of lighthouses. That mission continued as the Transatlantic Programs Center helped the U.S. Agency for International Development rebuild buildings damaged in the U.S. Embassy bombing in Nairobi. In addition, Albuquerque District is building facilities for the U.S. Border Patrol.

Throughout the years, the Corps of Engineers has kept pace with our nation, supporting and building it in thousands of ways. As we enter our 225<sup>th</sup> year, we continue writing chapters of our history that parallel the growth and life of the United States.

*ESSAYONS!*

**JOE N. BALLARD**  
Lieutenant General  
Commanding

## Mobile supports SOUTHCOM move

Article by Tim Dugan  
Photo by Dan Prine  
Mobile District

Mobile District is the direct support district to the U.S. Southern Command (SOUTHCOM) in its theater of operations in Central and South America. When the Department of Defense decided to relocate SOUTHCOM Headquarters from the Republic of Panama to Florida, Mobile District was asked to support the move, according to Dan Prine of the Latin America Project Management Team.

Mobile District's Latin America Team has been busy in the past two-and-a-half years completing required missions. Besides relocating SOUTHCOM to Miami, Mobile District was instructed to support the move of U.S. Army South (USARSO) and U.S. Special Operations Command South (SOC SOUTH) to the Commonwealth of Puerto Rico.

Mobile District provided the programming, planning, and design support for both organizations and provided the environmental assessments, as well as supporting both commands in negotiations with the State Historical Preservation Office.

The U.S. Navy ultimately executed the construction mission for SOC SOUTH at Naval Station Roosevelt Roads in Puerto Rico, once all the programming, planning and concept designs were provided to SOC SOUTH by Mobile District.

When Congress finally lifted its hold



**Contractors repair a roof at Fort Buchanan in Puerto Rico. More than 40 buildings were renovated or repaired for the arrival of U.S. Army South.**

on the USARSO move to Puerto Rico in August 1998, the Corps had about one year to finalize the designs and complete the construction. To accomplish this, Mobile District's Latin America Team, using the "One Door To The Corps" business concept, handed off the contracting functions to Huntsville Center, which had specialized Indefinite Delivery/Indefinite Quantity construction contracts

readily available.

The construction administration functions went to Jacksonville District, which had a large experienced construction administration and real estate organization in place in San Juan, Puerto Rico.

Omaha District and the Waterways Experiment Station were consulted for engineering and technical assistance as needed.

Mobile District provided the engineering design support. Within one year of receiving the authority to begin construction to support the USARSO move, USARSO successfully stood up its headquarters in Fort Buchanan, Puerto Rico, with all sections operational.

More than 40 buildings have been renovated. Numerous parking areas have been repaired or built. Two utilities projects have been awarded to put utilities underground. The 249<sup>th</sup> Engineer Battalion (Prime Power) provided backup generator power for USARSO. Uninterruptible power source, fuel tanks, and house trailers were procured. The new underground local area network system has been surveyed.

More than \$3 million of systems furniture was purchased and installed. Landscaping has been provided. A new masterplan and Geographic Information Systems have been initiated.

Utility studies are on-going. Multiple real estate actions have been executed. Two design contracts have been awarded for the Directorate of Public Works.

Currently, the Mobile District team continues the "one door to the Corps" concept by managing military construction funding for SOC SOUTH and USARSO, real estate actions (delegated to Jacksonville District), environmental actions, cultural resources actions, and contracting support.

*(Dan Prine contributed to this article.)*





The Zussman Urban Combat Training Complex is a realistic village covering 26 acres at Fort Knox. Carefully controlled flame effects are one of its features. (U.S. Army Photos)

# Urban combat complex offers realistic training for soldiers

By Ardis Moonlight  
Louisville District

A "war-ravaged city" on 26 acres in the hills of Fort Knox, Ky., simulates urban warfare scenarios which soldiers might encounter during combat or peacekeeping operations. Police units, hazardous materials teams, and civilian disaster service teams will also use the complex to gain experience in emergency relief situations.

The Zussman Urban Combat Training Complex, begun in 1997 and completed this year, is specially designed for tank use. It is the most intense urban combat complex currently available. Andy Andrews, range control officer for the complex, said, "We can have tanks, Bradleys, light armored vehicles, or deal with hazardous materials scenarios."

The \$16 million state-of-the-art facility has 18 multi-story buildings, most intact and some in rubble. It is controlled by a \$1 million computer system that manages pop-up targets, fire and special effects, and the sounds of a city.

The sound system, for instance, can play the voices of children in any language needed, the noise of helicopters approaching, or the roar of tanks a few blocks away. Even the street signs can be changed to the appropriate language to complete the sense of another country.

And the structures within the city are typical of a populated area — apartments, houses, a church, a hotel, office buildings, an open-air market, a bank, a school, and a convenience store. The complex also has exploding gas lines, a collapsing bridge, flame effects and live power lines, thus giving participants valuable knowledge about dangers in urban combat.

The effort to give soldiers the full effect of conditions in a war-torn city are managed to the smallest detail. Troops crawling through the four-foot sewer pipes that connect buildings in the city encounter a dark smoke-filled environment with simulated liquid sewerage complete with accurate smells.

Propane tanks at various sites throughout the city can create a variety of flame effects and fireballs, so safety tops the list for the entire operation. Sensors are located within the complex to shut down a flame effect if someone breaks a sensor beam in the area where a sequence is about to occur. The safety system also involves three people for further assurances



Two soldiers of the 101st Airborne Division defend a "damaged" building. (U.S. Army Photo)

— one verifies that the area is free of people, one has control of the key to initiate the effect, and an operator in the control tower has to be signaled to push the button to start a sequence.

To create this environment involved a lot of decisions. "Coordination was a big factor on this job, because it's the first of its kind," said Scott Hearn, Louisville District's construction representative.

Hearn was responsible for overseeing the quality and safety of the work. "The buildings had to physically appear to be bombed, yet be structurally sound so they're safe for people."

For instance, one of the two-story buildings appears to have a sidewalk supported by columns on

the second floor. "Actually, the sidewalk is cantilevered and the columns are false," said Hearn. "Otherwise, if a tank swung around the corner and hit real columns, the sidewalk would collapse."

Barry Stanfield, with Ware Energy in Louisville, Ky., which created the pyrotechnics and developed the computer system to control the action, took engineers and Fort Knox officials to Las Vegas to study reenactment battles performed on a simulated pirate ship in a casino. Propane gas is used to create the flame effects.

"The engineers were originally considering using liquid propane. That material is very dangerous, very difficult to control, and before you know it, someone could be badly burned," Stanfield said. "When you get involved in using fire around an audience, strong national codes have to be followed. Once we drew up the computer program that controls the fire effects, the Army follows it explicitly, for the liability on this is so great."

The time troops spend at the complex varies. "It depends on the unit size, their mission, and what their commander wants to accomplish," said Andrews. A SEAL team just learning the ins-and-outs of urban warfare may come for only 45 minutes, while a battalion from the 101st Airborne Division could stay for two weeks. Many groups do night training at the city, which operates 24 hours a day. Some troops bivouac in the city the entire visit, sleeping in the buildings, which have some furniture.

For training, the complex functions much like the National Training Center at Fort Irwin, Calif. It is wired for both video and sound. Officers in the control tower (disguised as a water tower) can watch the action in real-time, and also watch video recordings to study the action play-by-play. Soldiers' weapons are fitted with the Multiple Integrated Laser Engagement System so that the complex's computer can keep track of simulated kills.

The site has already attracted international interest. Representatives from Italy, Spain, England, and France have visited the complex, and Canadian troops have trained there. "Even the Marines, Air Force, and Navy are using Zussman," said Andrews.

The complex officially opened April 20 with a demonstration for the 2000 Armor Conference. The site is named in honor of 2nd Lt. Raymond Zussman, a Medal of Honor winner killed during World War II.



# Plastic grids may replace sandbags

Article by Wayne Stroup

Photos by Gary Dill

Waterways Experiment Station

*"The flash flood hit this morning after two days of heavy rainfall. As local streams and rivers erupted from their banks, the floodwaters completely inundated the municipal water treatment plant and forced evacuation of the hospital, overwhelming sandbagging operations. Damages will be in the millions of dollars and repairs could take months..."*

News stories like that may soon be history in many instances thanks to a cooperative research partnership involving a small business, the U.S. Army Corps of Engineers, and a new flood fighting material originally developed for military roads.

For decades, the main tool in fighting floods has been the sandbag — simple to operate, but labor intensive and slow to emplace. The Corps has a long history of fighting floods with sandbags. Al Arellanes has been involved in flood fighting for more than 20 years as both a contractor and as a government official, and he knew there had to be something better than sandbags.

In 1984, Arellanes became involved as a contractor with research at the Waterways Experiment Station (WES) site of the Engineer Research and Development Center to build field fortifications using a unique expandable plastic grid system.

The expandable "sand grids" were invented a few years earlier by Steve Webster at WES to stabilize expedient military roads across beaches and similar soft soils. The Corps later patented the grid cells.

To build roads, the plastic sand grids are expanded and filled with sand, soil, and other local materials to form a stable roadway base. Other WES researchers thought the grids could be used to build expedient field fortifications by stacking them on top of each other to form protective walls and bunkers.

"I started working on the field fortification effort with Capt. Andy Hamlin at WES," said Arellanes. "But early on, we saw limitations in the commercially manufactured sand grids used at that time for roads."

Arellanes altered the existing roadway grids until he developed his improved version, the Rapid Deployment Fortification Wall (RDFW). He sold his first RDFW to WES in 1985. Limited research continued on the grids for fortifications, but they never saw widespread use.

Through the years, Arellanes kept tinkering with the grids and improving them by using different plastics (including recyclable), different grid cell sizes and configurations, and different collapse-expand designs.

The early 1990s saw Arellanes working for the Federal Emergency Management Agency (FEMA) as a disaster assistance manager at flood events. Working a static flood in northern Cali-



The grid wall took more than 72,000 waves up to three feet high in the L-shaped wave flume at WES with minimal damage.

fornia, it hit Arellanes that stacked grids, similar to the concept for field fortifications, could be used as an alternative to sandbag walls for flood protection. He left FEMA to work on the grids as a new effective flood-fighting tool.

"We did more than 20 site demos of RDFW for flood fighting throughout California to various agencies," said Arellanes. "Each time, the officials liked it, but said 'We need more data.'"

In 1996 Arellanes contacted Phil Stewart at WES about getting a license to use the Corps-patented grids. Stewart runs the Office of Research and Technology Applications. Working with Stewart, Arellanes eventually established a Cooperative Research and Development Agreement (CRADA) with WES. A CRADA is a research partnership between a federal laboratory and private industry.

"CRADAs benefit our research program by providing extra funding, they help private industry develop better products by using our unique facilities and expertise, and it helps the nation by providing better and safer construction materials, techniques, and methods," said Stewart. "We've done more than 100 CRADAs in the past seven years. In FY 99 we leveraged almost \$1 million in extra research funding. CRADAs are a win-win situation."

The CRADA between WES and Arellanes and his joint venture partners, Ron Brewer (a Native American 8-A small business contractor) and Rey Rodriguez, allows joint research and development tests of Arellanes' RDFW grid system. WES supplied unique research facilities and equipment, technicians, and an engineer, while Arellanes and his partners provided their time, laborers, materials, and built the wall.

The research product will be a written report that can be used by both the Corps and Arellanes. "When he goes before FEMA or other federal or state agencies, Arllanes can say, 'This has been tested by the Corps and here are the results,'" said Stewart.



Steve Webster and Al Arellanes examine a section of the Rapid Deployment Fortification Wall.

They used the L-shaped wave flume at WES to conduct the tests. This unique research facility is 250 feet long, up to 80 feet wide, and seven feet deep. Designed for coastal research, the flume was perfect to put real water loadings on the grid wall, including wave action.

Research hydraulic engineer George Turk headed up the WES support. Turk brought a lot of hydraulics research experience to the test, and he has worked on a variety of CRADAs, mostly on coastal breakwater design. Most importantly, Turk served on a research team that conducted field surveys of expedient flood fighting techniques immediately following the 1993 Upper Mississippi River Flood.

"During the '93 flood, we saw an awful lot of examples of bad sandbagging," said Turk. "I don't want to take anything away from the efforts of the flood-fight volunteers but, in truth, it is very difficult to build a proper sandbag levee without extensive training and experience."

The RDFW grids tested at WES have a collapsed size of four feet by four feet by half an inch, but expand to four feet long, four feet wide, and eight inches high. The grids are stacked and interlock at the top, bottom, and sides to form a continuous cell wall structure. The stacked grids are quickly filled with sand by a front-end loader. The test wall at WES was four feet high and 50 feet long in the flume.

"It's interesting to see this concept become a reality," said Arellanes. "It was amazing to see 40 inches of static water against the wall with only eight inches of freeboard. When we started making waves hit the wall, I was impressed by the wave energy and the consistency the wave machine developed. Each time we ran a test, we raised the bar on the wall's capabilities."

The wall held up incredibly well throughout the testing. The static water load simulating a normal flood event putting little stress on the grid wall. Even under the pounding of more than 72,000 cycles of waves up to three feet in height, the wall showed little evidence of wear and tear.

According to Arellanes, a seven-man crew can build a 100-foot-long, 48-inch-high wall of RDFW in one hour. It would take a 35-man crew up to eight hours to build the same length and as stable a wall with sandbags. RDFW is also reusable for up to six flood events, whereas sandbags cannot be reused and often must be disposed at designated landfills.

With Turk's past flood fighting insight, he is also enthusiastic about the potential for RDFW. "This grid is so simple to use, even volunteer labor could quickly build protective structures that meet construction standards. It could easily protect high-value assets. You could ring such structures quickly with a grid wall. In flood fights, you could use grids to quickly and efficiently close gaps in levees for railroad crossings, roads, and such."

The grid also has great potential in raising levees, according to Turk. "Levees are narrow on top, usually only the width of a road. If you're going to raise a levee elevation with sandbags, say four feet, then the base must be at least 12 feet wide. You flat run out of room to work. A grid wall may only require one or two sections."

Arellanes is very enthusiastic about RDFW and the joint research effort. "With the documentation from these tests, we can show people that we have the product to satisfy their emergency flood fighting needs. By eliminating the labor to emplace sandbags, you can greatly improve the levels and amount of protection during a flood event."

Arellanes' biggest problem in the future may be in determining all the potential applications for RDFW — raising levee crowns, sheet flows on roads, static rises, protecting vital assets, diverting storm water, wind-driven wave flooding, hurricane storm surges. The RDFW may lead to increased flood protection for people and property across the country.





Developers purchase "credits" in a wetland mitigation bank to offset environmental damage done by their projects. Work done in the mitigation bank (left) creates high-quality wetlands which are ecologically viable for the long term. (Photos courtesy of Sacramento District)

# Mitigation banks replace lost wetlands

By Cynthia Neff  
Sacramento District

A novel concept has arisen in banks around California. You can now go to an ATM, enter your pin number and withdraw...*land!*

Well, not actual land, and not at a normal bank, either. But the idea of wetland mitigation banking is catching on in California, spurred by a new firm called Wildlands, Inc., one of the first wetland mitigation banks in California. Others have been established elsewhere in the nation. The company owns and operates six wetland mitigation bank facilities, the first established in 1994.

According to the *Federal Register's* "Federal Guidance for the Establishment Use and Operation of Mitigation Banks," Nov. 28, 1995, wetland mitigation banks are "for the purpose of providing compensation for adverse impacts to wetlands and other aquatic resources." They are for "wetlands restoration, creation, enhancement and, in exceptional circumstances, preservation." And the need to protect California's wetlands is reflected in reports that more than 95 percent of the Central Valley's wetlands have been lost to agriculture and development.

The concept behind wetland mitigation banks is involved, but fairly simple. Ever since the Bush administration established the standard of *no net loss of wetlands*, one of the biggest challenges a developer faces is making up for unavoidable habitat losses. The developer must purchase, cultivate, and maintain a wetland habitat to compensate for the land that his development destroys. This can be time-consuming and costly.

Wetland mitigation banking provides a cost-effective and convenient solution. Here's how it works—the developer of the wetland mitigation bank buys land and creates a variety of wetland habitats. The U.S. Army Corps of Engineers, working with the U.S. Fish and Wildlife Service, the Environmental Protection Agency, and the California Department of Fish and Game evaluates the habitats and assigns a certain number of "credits" to them. The developer sells these credits to builders or government agencies like the Corps to offset the effects of construction projects.

A "credit" is essentially a unit of habitat value. The money given to the mitigation bank developer pays to have the wetlands created or improved, and maintained. A credit costs a developer \$50,000 to \$75,000 an acre, according to Steve Morgan, chief executive officer of Wildlands, Inc., but that's cheap compared with the time and expense of restoring wetlands and vernal pools to satisfy environmental rules.

"Mitigation banking is a win-win for everybody," Morgan said. "You're creating a compound of nature that's better in size and scale. Plus, a developer can expedite his land development process, saving time

on environmental engineering. It complements the community and nature simultaneously."

"By purchasing credits from the bank, developers can compensate for project-related impacts and avoid development and management of isolated, site-specific mitigation areas that may not be ecologically viable over the long term," said Jim Monroe, Chief of the Corps' San Joaquin Valley Regulatory Office.

The Corps has worked with Wildlands Inc., several times to compensate for projects. Recently Monroe needed a few acres of wetlands to mitigate for a development and called Morgan. Monroe was considering Prospect Island, but Morgan had access to Kimball Island, a 109-acre tract in southwest Sacramento County.

The island lies at the confluence of the Sacramento and San Joaquin rivers, an important area in the Delta ecosystem for fish production, particularly the Delta smelt and various salmon species.

Monroe decided to go with Wildlands, Inc. and initiate an interagency effort to work with them to reestablish the diverse aquatic, wetland, and riparian habitats that were once prevalent in the Delta.

Monroe sees Wildlands, Inc. as a good way to solve the mitigation issue. "Mitigation areas are a real need, and they are met by the private sector," he said.

Mitigation banks are not only attractive for developers, they also give government agencies another option when their projects require mitigation. Agencies usually develop their own mitigation sites, which can take a considerable time and staff resources. When those resources are scarce, purchasing mitigation credits from a bank can be the "silver bullet" project managers need to keep things on schedule.

For example, in 1997 Sacramento District was working on the Sacramento Riverbank Protection Project and determined that about an acre of emergent marsh habitat would be impacted from bank protection work on Steamboat Slough. Time was short and the customer, The Reclamation Board, was having difficulty locating a suitable piece of land to acquire. Project manager Creg Hucks proposed buying mitigation credits from the Kimball Island bank rather than finding, developing, and maintaining habitat. The customer agreed and the credits were purchased from Wildlands, Inc.

"By purchasing the mitigation credit we reduced both the project and schedule cost by eliminating mitigation plan development, lengthy multi-agency reviews, finding and acquiring land, and a host of other time-consuming steps," said Hucks. "By utilizing the Kimball Island mitigation bank, the Sacramento River Bank Project stayed on track and solved the Reclamation Board's land acquisition dilemma. The mitigation banks are a wonderful tool that helped the Sacramento team be responsive."

Future mitigation needs for bank protection work

in the San Joaquin Delta are planned at a 176-acre wetland mitigation area, the Cache Slough/Yolo Bypass Mitigation Area about eight miles north of Rio Vista. The area supports a mixture of habitats, including riparian scrub-shrub, shaded aquatic cover, and emergent marsh habitat. The mitigation banking agreement is being finalized for the area to be a wetland mitigation bank for the Sacramento River Bank Protection Project. This mitigation bank will be the first in the U.S. created specifically for a Corps civil works project. The Reclamation Board will operate and maintain the wetland mitigation bank.

(Jim Monroe and Creg Hucks contributed to this article.)

## Mother makes do in WW II

By Beth Sauls  
Tulsa District

Sometimes we follow in our parents' footsteps without knowing it.

I knew my mother had worked for the government during World War II, but I wasn't really aware of which agency. By the time I was old enough to ask, I was too self-involved, as children are, to ask about it.

Then I started working for Tulsa District.

Imagine my surprise when my mother said, "I worked there during the war." Of course, to my mother's generation, World War II is "The War." Come to find out, she also worked in real estate, just as I do!

Did you know that back then they used heavily starched and glued linen to make originals for blueprints and maps? Mother told me that when these were discarded, she would take them home, wash out the starch and glue, bleach out the ink, and make little blouses for me. She would embroider all sorts of small flowers on the collars and cuffs.

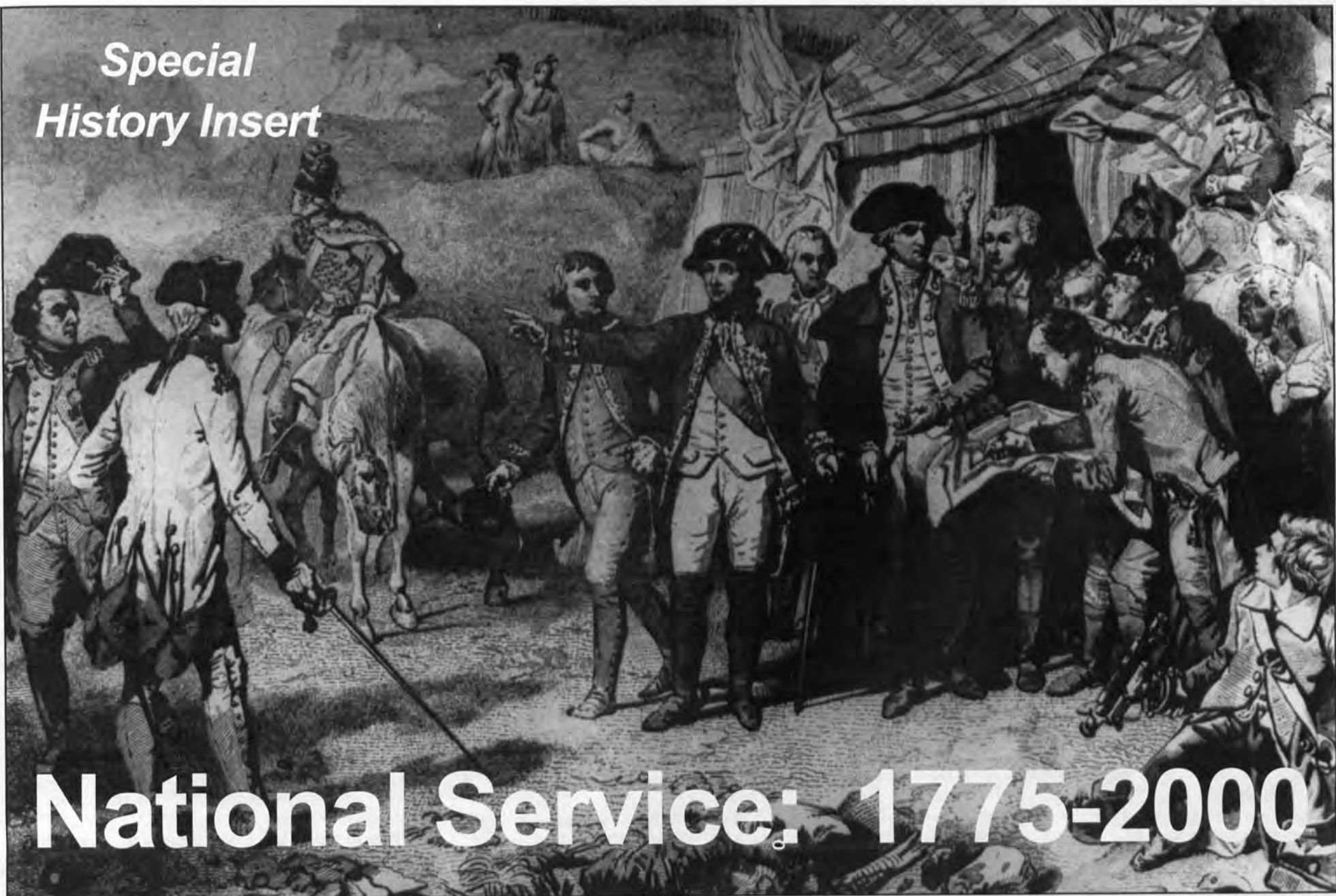
She recycled long before it became a buzzword. Back then, they just called it "making do."



A 1940s photo shows Beth Sauls in a blouse sewn from map linen.



## Special History Insert



Generals Washington and Rochambeau and their staffs plan the siege of Yorktown. Engineers played an important role in the battle. They dug trenches to allow troops to approach British lines unseen. A force of American soldiers took Redoubt Ten during the battle. They were led by the forerunners of combat engineers, a group of soldiers carrying only axes to cut through sharp-stake fortifications. (Photo courtesy of the Office of History)

### Beginnings

The U.S. Army Corps of Engineers traces its history back to June 16, 1775, when the Continental Congress organized an army with a chief engineer and two assistants. Col. Richard Gridley became Gen. George Washington's first chief engineer. Army engineers first formed into a Corps by resolution of Congress on March 11, 1779. They were instrumental in several Revolutionary War battles, including Bunker Hill, Saratoga, and Yorktown.

At the end of the Revolutionary War, the engineers mustered out of service. In 1794, Congress organized a Corps of Artillerists and Engineers, and in 1802 re-established a separate Corps of Engineers. The Corps' permanent existence dates from that year.

**Rebirth.** From the beginning, politicians wanted the Corps to contribute to both military and civil projects. Throughout the 19th century, the Corps supervised construction of coastal fortifications, built lighthouses, helped develop harbors, and mapped navigation channels.

Once re-established in 1802, the Corps of Engineers began building and repairing fortifications. The fortification assignments proliferated before the War of 1812. The Chief Engineer, Col. Jonathan Williams, expanded the fortifications protecting New York Harbor. These defenses prevented the British navy from attacking New York Harbor during the War of 1812.

After the War of 1812, the U.S. expanded its fortifications as the first line of land defense against attack. Congress reduced the size of the infantry and artillery after the war, but retained the officers authorized for the Corps of Engineers. Pleas from several secretaries of war for more engineers for fortifi-

cation work led Congress to double the number of engineer officers and divide them into two Corps (the Corps of Engineers and the topographical engineers) in 1838. They reunited into a single Corps in 1863.

### Transportation

Although fortifications were important, perhaps the greatest gift the early Corps gave the young nation were canals, river navigation, and roads. Rivers were America's paths of commerce. They provided routes from western farms to eastern markets, and for settlers seeking new homes. But the rivers could also destroy boats with snags and sandbars. From those unruly streams, Army engineers carved navigation passages and harbors.

**Authority.** In 1824 the Supreme Court ruled that the commerce clause of the Constitution included river navigation. Congress passed two laws that profoundly affected the future of the Corps. The first, the General Survey Act authorized the president to survey routes for roads and canals, which was delegated to the Corps of Engineers. The second act appropriated \$75,000 to improve navigation on the Ohio and Mississippi rivers by removing sandbars, snags, and other obstacles. Later amendments included other rivers. The Corps, the only trained engineers available to serve Congress and the executive branch, got this work.

**River work.** The work was important. Much of it was done by the topographical engineers, who reported to a Topographical Bureau in the Engineer Department. As surveyors, explorers, cartographers, and construction managers, the "topos" helped open the nation to development and settlement.

Congress expanded the engineers' work in 1826 by authorizing additional surveys, providing navigation improvements on inland rivers, and building harbor jetties. This act was the first to combine authorizations for both surveys and projects, establishing a pattern that continues to this day.

Removing sandbars in the Ohio River was an early project of engineer innovation. By September 1825, Maj. Stephen Long, working on the Ohio River below Henderson, Ky., had built a wing dam with two rows of more than 600 wooden piles. Theory and empirical data agreed that the increased velocity should reduce the sandbar and increase river depth. Long figured out the angle and length for the dam, and it was the prototype for many others along the Ohio River.

**Snag boat.** But Long wasn't satisfied because he knew the dam would not prevent sandbars. The Ohio would carry sediment downstream, forming bars at many different points. Long convinced Col. Alexander Macomb, Chief of Engineers, to sponsor a contest to find a machine to eliminate navigation obstructions. The winner would receive \$1,000 and a contract to open up the Ohio River.

But the winner designed a boat of limited use and argued with Macomb over contract terms. Long suggested replacing him with Henry Shreve, a man known for navigation skill and pioneering efforts to bring commerce to the Mississippi Valley.

Shreve built a revolutionary steam-powered snag boat. Put into service in 1829, Shreve's boat rammed into snags, jarring them loose. The limbs were hoisted and broken apart on deck. The impact of the

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snagboat and those that followed was dramatic. Insurance and shipping rates dropped, and shipping increased on the Mississippi and Ohio rivers.

**Dredges.** 1853 saw a milestone in dredging history, when the Corps contracted for the first hopper dredge and used it in Charleston Harbor. The dredge used two large dippers to dig into the harbor bottom, lift up sediment, and deposit it in a hopper in the hull. At a disposal site, the dredge dumped the material through well holes in the hopper. Earlier dredges needed another vessel to haul material to disposal sites, but the hopper dredge could do it all.

The Corps replaced this early dredge in 1857 with the *General Moultrie*, a hopper dredge using a centrifugal pump to suction up sediment. This was the world's first hydraulic dredge, the prototype for all future hopper dredges.

**Locks and dams.** After the Civil War, an Army Engineer Board concluded that locks and dams on the Ohio River was preferable to wing dams, dredging, and canals. Maj. William Merrill, in charge of Ohio River improvements, needed to develop river regulation dams to allow coal barges to pass. He concluded that the wicket dam designed by Jacques Chanoine in 1852 was best for the Ohio River, and in 1874 he proposed that a series of movable dams employing Chanoine wickets be built.

Congress approved Merrill's plan in 1877, and the Corps began building the Davis Island project near Pittsburgh. The 110x600-foot lock and 1,223-foot dam were the largest in the world at the time. The Davis Island Lock was also one of the first to use concrete. This success led Congress to authorize extending the project down the Ohio, which was completed in 1929.

**Canals.** Throughout the 19th century, engineer officers built, maintained, and rehabilitated canals and river navigation features. They surveyed canal routes on the Chesapeake and Ohio rivers and Muscle Shoals. Several Army engineers launched their careers at Muscle Shoals canal after the Civil War, including George Goethals. The nation would call on Goethals again for the Panama Canal.

Canal building continued in the 20th century. After the federal government purchased the Chesapeake and Delaware Canal in 1919, Wilmington (Delaware) District deepened the channel and added bridges. Traffic increased, and demands were made to enlarge it. The canal became part of an intercoastal waterway to connect bodies of water from Boston to Key West to the Rio Grande. Today, the Corps retains responsibility for this canal and the entire Intracoastal Waterway.

**Surveys.** Besides building canals, locks, and other navigation features, Army engineers performed important surveys, especially the Great Lakes and Mississippi Delta. Topographical engineer Capt. William Williams, superintendent of harbor improvements on Lake Erie, headed the survey.

From 1841 to 1860, surveyors measured the discharge of rivers into the Great Lakes; surveyed rivers, narrows, and shoals; developed charts and maps; and marked danger points. The Corps continued this work until 1970, when much of the mission transferred to the National Oceanic and Atmospheric Administration. Detroit District still forecasts lake levels.

The Mississippi Delta survey had an importance out of proportion to the funds invested. In September

1850, responding to congressmen seeking assistance to fight floods that struck lower Mississippi River communities, Congress appropriated \$50,000 for a topographical and hydrographic survey of the delta. This included studying the best way to secure a 20-foot navigation channel at the river mouth.

Topographical engineer Capt. Andrew Humphreys led the survey, but the field work of 2<sup>nd</sup> Lt. Henry Abbot was so indispensable that

Humphreys named Abbot co-author of the report. It was full of new details about the Mississippi Basin from the Ohio River to the Gulf. They obtained data on river flow, channel cross-sections, and topographical and geological features.

The conclusions of Humphreys and Abbot influenced the development of river engineering and the evolution of the Corps. The authors believed that levees alone could control flooding along the lower Mississippi. The Corps accepted this for nearly 60 years.

**Roads.** In the 19th century the Corps also built roads. The most famous was the Cumberland or National Road built between 1811 and 1841. It extended from Cumberland, Md., across the Appalachian Mountains to Wheeling, West Va., and then across Ohio and Indiana to Vandalia, Ill.

In building the National Road, the Corps applied asphalt-paving techniques developed in England, and innovative bridge construction. At Brownsville, Penn., Capt. Richard Delafield built the first bridge in the U.S. with an iron superstructure, an 80-foot span still in use. By 1840 engineer officers had overseen construction of 268 miles of paved road.

**Railroads.** Engineer officers also supervised railroad work after 1824. They surveyed routes and, once construction began, the War Department loaned engineers to the railroad companies. By 1830 many officers were granted furloughs to work on railroads in either construction or surveying.

**Westward ho!** In the 1850s westward expansion generated interest in a rail link from the Mississippi River to the Pacific Coast, and topographical engineers surveyed four alternate routes, gathering a great deal of scientific information at the same time. The Corps sponsored two more surveys after the Civil War. One survey explored the 40th parallel route from the eastern slope of the Sierra Nevada to the western fringes of Wyoming and Colorado, while the other explored the Southwest. Both expeditions produced a wealth of data on the natural history of the West.

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## Mexican and Civil wars

**Mexican War.** Engineers of all ranks gained renown for service in Mexico in 1846-48. Chief Engineer Joseph Totten directed the successful siege of Veracruz, from which Gen. Winfield Scott launched his decisive assault on the interior of the country. Capt. William Williams, who directed the Great Lakes survey, served as chief topographical engineer for Gen. Zachary Taylor until his death at the battle of Monterey.

**Civil War.** During the Civil War, Army engineers built bridges, forts and batteries, demolished enemy supply lines, and conducted siege warfare. In December 1862 they laid six pontoon bridges across the Rappahannock River, under heavy fire, to support the Union attack on Fredericksburg, Va. The 2,170-foot pontoon bridge which Union engineer troops laid across the James River in June 1864 near Petersburg, Va., was the longest floating bridge until World War II.

Army engineers during the Civil War included many excellent military strategists who rose to leadership roles. Among them were Union generals George McClellan, Henry Halleck, and George Meade, and Confederate generals Robert E. Lee, Joseph Johnston, and P.G.T. Beauregard.

## A growing nation

In the early 19th century, the Corps built many projects to support the Department of Treasury. For instance, they helped build three customs houses and several hospitals to treat merchant seamen. Between 1831 and 1851, engineer officers also built dozens of lighthouses, which involved difficult, dangerous construction.

**Washington, D.C.** The Corps also contributed to building many public buildings and monuments in Washington, D.C. This began in 1822 when Isaac Roberdeau, a topographical engineer, supervised installing cast iron pipes to bring spring water to the White House. In 1853, responsibility for building a

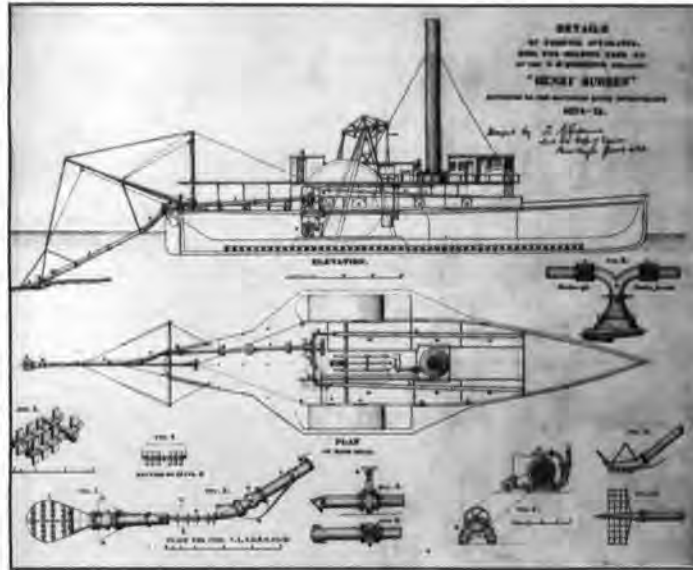
permanent water supply for Washington fell to Lt. Montgomery Meigs. His project included two bridges and water pipes over Cabin John and Rock creeks. The Cabin John Bridge, built 1857-64, remained the world's longest masonry arch for more than 40 years, and is still in use.

In 1867 Congress gave control of public parks and monuments to the Office of Public Buildings and Grounds under the Chief of Engineers, and in 1878 replaced Washington's elected officials with a three-man commission. An Army engineer called the Engineer Commissioner for the District of Columbia

served on that board and was responsible for the city's physical plant until Congress approved the district's current home rule in 1967.

During the last half of the 19th century, the Corps improved navigation on the Potomac River; expanded the local water supply; completed the Washington Monument; helped design and build numerous structures including the Executive Office Building, the Lincoln Memorial, the Library of Congress, and the Government Printing Office; reclaimed swampland

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The first hopper dredges were designed by the Corps Engineers. (Photo courtesy of the Office of History)



Army engineers played an important role in exploring the West. Above, Lt. Wheeler's 1871 expedition begins its journey up the Colorado River. (Photo courtesy of the Office of History)



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to create the Tidal Basin; and developed Rock Creek Park.

**Mississippi River Commission.** The Corps became involved in flood control after the Civil War, particularly on the Mississippi where floods impaired commerce, destroyed property, and cost lives. In 1879 Congress created the Mississippi River Commission (MRC) composed of three people from the Corps (including the president), three civilians (including at least two civil engineers), and one from the U.S. Coast and Geodetic Survey. Congress created the MRC to insure that the best advice from both the military and civilian communities was heard to improve the Mississippi River for navigation and flood control.

After much debate, the commission decided to rely on levees to protect the lower Mississippi Valley. Co-operating with local levee districts, the MRC oversaw building many levees along the river. Later, considerable dredging supplemented levee construction. The MRC also attempted to stop bank erosion with willow mattresses. In the early 20th century, the Corps developed the articulated concrete revetment now used to protect the riverbanks.

**California Debris Commission.** In 1893, Congress formed the California Debris Commission (CDC) made up of three Army engineers to

regulate California streams devastated by sediment from mining operations. Given substantial power, the CDC significantly reduced damage.

**The first 100 years.** In 1917, as the U.S. faced World War I, the Corps could look back with satisfaction. The work of engineer officers had been impressive. For instance, after the 1900 hurricane, former Chief of Engineers Henry Robert chaired a commission to plan the Galveston Seawall.

Hiram Chittenden supervised building roads, bridges, and aqueducts in Yellowstone National Park. His survey of reservoir sites in Wyoming and Colorado helped establish the Bureau of Reclamation. He wrote several works about the early exploration of the Missouri River Basin, and became a recognized expert on flood control.

Goethals' work at Davis Island and Muscle Shoals gave him the expertise to finish the Panama Canal. It was built by the Panama Canal Commission, not by the Corps. But Army engineer officers detailed to the commission helped overcome some of the most difficult construction obstacles.

## World War I

The British and French governments made American engineers their top priority after the U.S. entered World War I in April 1917. By the end of August, nine new engineer railway regiments and the engineer regiment of the 1st Division had arrived in France. While serving with the British near Cambrai, France, on Sept. 5, Sgt. Matthew Calderwood and Pvt. William Branigan of the 11th Engineers were wounded by artillery, becoming the first U.S. Army casualties in Europe.

The engineer troops who served in France 1917-18 contributed to both front-line and rear support. The combat engineers built bridges, roads, and narrow-gauge railroads at the front. The forestry troops of

the 20th Engineers produced about 200 million feet of lumber. Other engineer troops enlarged French ports, built more than 20 million square feet of storage space, and 800 miles of rail lines, plus an equal distance in rail yards and storage tracks.

Engineers also organized the first U.S. tank units and developed chemical warfare munitions and defensive equipment. These proved so important that in 1918 the War Department created a separate Tank Corps and a Chemical Warfare Service.

## Multipurpose development

Neglected waterways and the need hydropower and irrigation in the West drew attention to water resources early in the 20th century. Multipurpose partisans advocated applying scientific management to ensure efficient water use. This meant a program of development to address all applications of water resources. Back then, water unused was considered "wasted" water.



Multipurpose projects like the Fort Peck Dam in Montana became a Corps mission in the early 20th century. (Photo courtesy of the Office of History)

**Hydropower.** Unlike the West, where irrigation was the initial focus, the East needed hydropower. Beginning in the early 1880s, when a plant in Appleton, Wis., first used water to produce electricity, hydroelectric dams proliferated. These private dams threatened navigation and forced Congress (through the Corps) to regulate dam construction. Acts passed in 1890, 1899, and 1906 required that dams be approved by the Secretary of War and the Corps.

Private interests developed most power projects before World War I. The Corps installed a power station at Lock

and Dam 1 on the upper Mississippi River. The government later leased it to Ford Motor Company. In 1919, the Corps began building Dam #2 (renamed Wilson Dam) as a hydroelectric facility at Muscle Shoals on the Tennessee River.

President Franklin Roosevelt favored federal hydropower projects to provide low-cost energy. During the New Deal, the Corps participated in three major hydroelectric projects — Passamaquoddy Tidal Power Project in Maine, Bonneville Dam on the Columbia River, and Fort Peck Dam on the Missouri River. In 1937, Congress created the Bonneville Power Administration to sell power generated at Bonneville Dam.

**Floods.** Meanwhile, concern about flood control grew. In 1912-13, two floods devastated the lower Mississippi Valley and showed the inadequacy of the levee system. Another flood came in 1916, and Congress passed the first flood control act the following year for the Mississippi and Sacramento rivers.

Still, the MRC and the Corps continued to depend on levees. That policy changed in 1927, when one of the worst floods in history hit the lower Mississippi. Between 250 and 500 people were killed, more than 16 million acres were flooded, and more than 500,000 people were forced into refugee camps.

Clearly, levees were not the answer. Maj. Gen. Edgar Jadwin, Chief of Engineers, drew up a plan to disperse water through controlled outlets and floodways, while still retaining levees. Congress approved this plan in the 1928 Flood Control Act. This act launched what today is called the Mississippi River and Tributaries Project, which has prevented billions of dollars of flood damage.

**Flood legislation.** Floods continued elsewhere. In addition, the 1930s saw the Great Depression. Responding to the need for flood protection and work relief, Congress passed the 1936 Flood Control Act which declared that flood control was a proper federal activity. The Corps had already built a few reservoirs, but this declaration made reservoir construction a major mission. It also established that a potential project's economic benefits must exceed its costs. Furthermore, the act specified obligations to be assumed by local interests before the Corps could begin certain projects.

**Pick-Sloan.** The 1944 Flood Control Act empowered the Secretary of the Interior to sell power produced at federal projects. The act also authorized the giant multipurpose civil works project for the Missouri Basin called the Pick-Sloan Plan. It combined the plans for developing the Missouri Basin proposed by Maj. Gen. Lewis Pick, formerly Missouri River Division Engineer, and W. Glenn Sloan, the assistant regional director for the Bureau of Reclamation. The Corps built several huge dams on the Missouri River. These dams were all multipurpose, providing flood control, irrigation, navigation, water supply, hydropower, and recreation.

After World War II, federal multipurpose projects expanded. Congress authorized major hydropower systems on the Columbia, Snake, Missouri, and Arkansas rivers. By 1975, Corps projects produced 27 percent of the nation's hydropower.

## World War II

**New mission.** Shortly before the U.S. entered World War II, Congress and the War Department approved transfer of military construction from the Quartermaster Corps to the Corps of Engineers. The Army implemented the shift piecemeal. After the Destroyers for Bases Agreement of September 1940, Gen. George Marshall assigned the Corps to build air bases in British territories from Newfoundland to British Guiana. In November 1940, Marshall transferred all air base construction in the U.S. to the Corps. Finally, in December 1941, Congress gave the Corps responsibility for real estate acquisition, construction, and maintenance for Army facilities.

**Military construction.** Domestic base construction peaked in 1942, as the nation geared up for war. Military construction expenditures in July exceeded that spent from 1920 to 1938. By the end of 1942, the Army could house 4.37 million soldiers and provide hospital beds for 180,000. It had built 149 munitions and aircraft manufacturing plants, and depots with 205 million square feet of storage space.

**Combat.** In World War II, Army engineers built bridges across rivers in Italy, France, and Germany. They operated on beaches during assault landings in Europe and the Pacific. At Normandy, engineers under heavy enemy fire cleared lanes for landing craft by destroying mine-bearing steel struc-



Working under enemy fire, Ninth Army engineers build the first Bailey Bridge across the Rhine River during World War II. (Photo courtesy of the Office of History)

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tures and bulldozed roads up narrow draws through cliffs lining the beaches. During the Battle of the Bulge, engineers destroyed critical bridges, slowing the German advance while Allied forces regrouped.

The engineers also built roads across wilderness between Canada and Alaska, and between Assam Province in India and Yunnan Province in southwestern China.

## Korea and Vietnam

Engineer operations continued during the Korean War. They destroyed bridges over the Naktong River and built fortifications that helped American and South Korean forces hold the Pusan perimeter while Gen. Douglas MacArthur prepared his amphibious assault at Inchon. When Chinese forces entered the war and forced the Americans to retreat, the engineers built roads behind new defensive lines that permitted the movement of forces and equipment to areas under attack.

In Vietnam, engineers cut access to enemy strongholds to support search-and-destroy missions. To assist these efforts and reduce enemy attacks on military convoys, the engineers introduced the Rome plow, a military tractor equipped with a protective cab and a special tree-cutting blade.

Engineer troops also built 900 miles of highways connecting the major population centers of Vietnam, and monitored construction by private American contractors of another 550 miles of highways.

## Natural disasters

**Early action.** The Corps' first formal disaster relief mission was the Mississippi Flood of 1882, supporting the Quartermaster Corps' in rescuing people and property. Army engineers also played a critical role in the Johnstown, Penn., flood of 1889, and the San Francisco earthquake of 1906.

**Twentieth century.** In 1917, the Army reorganized its disaster relief responsibilities and assigned command and control during disasters to department or Corps area commanders. After major flooding in 1937, the Chief of Engineers ordered all Corps districts to develop flood emergency plans.

In 1947, the Corps responded to the explosion of 2,400 tons of ammonium nitrate on a ship in Texas City, Texas. Two years later, it handled its first major snow removal emergency, a massive blizzard on the Great Plains.

### Legislation.

By 1950, the Corps had a reputation for responding effectively to disasters. Under the Federal Disaster Relief Act of 1950, the Corps continued to be the lead federal agency

during floods. Five years later, Congress passed Public Law 84-99 which authorized the Corps an annual fund of \$15 million for flood emergency preparation, flood fighting and rescue, and repair or restoration of flood control structures.

**Disasters.** In 1964 the Corps responded to the Alaskan earthquake, and Hurricane Camille in 1969. The damage caused by these events and Tropical Storm Agnes in 1972 prompted Congress in 1974 to broaden federal responsibility for disaster assistance.

By the 1980s the Corps' mission had expanded from flood fighting to other hazards. So the Corps established an emergency management program. In 1988 the Robert T. Stafford Disaster Relief and Emergency Assistance Act authorized the Federal Emergency

Management Agency to handle all disasters. The Corps has worked closely with FEMA ever since.

Between 1989 and 1992, the Corps responded to the Alaska oil spill, Hurricane Hugo, and the Loma Prieta earthquake. Between 1992 and 1995 the Corps performed major repair work after Hurricanes Andrew and Iniki, the Midwest floods, and the Northridge earthquake.

## Research and development

**Early R&D.** Although the Corps is primarily an engineering and construction organization, it is committed to research and development (R&D). Some early R&D has been mentioned — Long's work on wing dams, Gillmore's early dredge boats, Merrill's use of concrete, and Humphreys' and Abbot's hydraulic theories. Stephen Long developed a new design for railroad bridges in the 1830s. The Long truss played a role in the transition from wooden to iron bridges.

**World War II.** The Corps' research burgeoned during World War II. The Engineer Board at Fort Belvoir, Va., led the effort.

Conducting tests at Fort Knox, Ky., and on the Colorado River near Yuma, Ariz., the board perfected a new steel treadway bridge that could be quickly laid on pneumatic floats for forces crossing rivers in Europe. The Engineer Board also developed improved equipment for road construction, mapping, and demolition. Working with private firms, in 1943 the Engineer Board procured the tank-dozer used to breach hedgerows in Normandy after D-day.

During this time, the Waterways Experiment Station helped develop the pierced-steel plank and prefabricated bituminous surface used for rapidly building airfields.

Today, the Corps' continues its R&D work at several laboratories under the Engineering Research and Development Center.

## New needs

**Post-World War II.** After World War II, the Corps developed and maintained new navigation systems like the McClellan-Kerr and Tennessee-Tombigbee waterways, and the American portion of the St. Lawrence Seaway.

Modernizing existing waterways became a growing concern. Heavier tows with larger barges plied the rivers, and locks like those on the upper Mississippi, built mainly in the 1930s, were

not adequate. Lock and Dam 26 near Alton, Ill., was a bottleneck until a new lock was built in the 1980s.

Some Corps' construction since World War II has been unusual. The Corps built Veterans Administration hospitals, missile sites; NASA facilities including the Vehicle Assembly Building at Cape Kennedy, postal facilities, and recruiting centers.

**Construction overseas.** Successes at home were matched by success abroad. Grecian District, established in 1947, restored Greece's transportation and communication networks damaged in World War II. Army engineers cleared the Corinth Canal, restored the port of Piraeus, and built or repaired more than 3,000 kilometers (1,860 miles) of roads.

The Corps set major precedents in Greece. For

the first time, a district supervised large civil works in a foreign country, and provided technical assistance with economic aid, now typical of many foreign assistance programs. Training native contractors to perform much of the work began in Greece.

Since the 1950s, the Corps has done engineering studies and projects in many countries. These include roads in Afghanistan, Iran, and other Middle Eastern countries; and air bases in Israel. Surveys dealt with transportation networks and entire public works programs. From 1959 to 1964, Army engineers examined port and highway projects and built airports, highways, and ports in Afghanistan, Burma, British Guiana, Iran, Korea, Pakistan, Saudi Arabia, and Somalia.

Under the Foreign Assistance Act of 1961, the Corps began work in re-

imbursable programs through the State Department's Agency for International Development. Beginning in 1963, the Corps undertook several large construction projects in Saudi Arabia. Between 1976 and 1986, this effort exceeded \$14 billion, the largest construction program in Corps history. The Corps also did reimbursable work in Iran, Jordan, Kuwait, and Libya. Almost all projects involved transportation networks like roads or airports.

## Environment

**Early environmental work.** The Corps' role in protecting water resources has continuously evolved. In the 1880s and '90s, Congress directed the Corps to prevent dumping in harbors, a program vigorously enforced. At Pittsburgh in 1892, the Corps took a grand jury on a boat tour of the harbor and obtained some 50 indictments of firms dumping debris. In 1893 the Corps forced one Ohio community to build an incinerator and burn refuse rather than dump it in the river.

In the Rivers and Harbors Act of 1899, Congress gave the Corps authority to regulate most obstructions to navigation, including effluents.

In 1911, Brig. Gen. William Bixby, Chief of Engineers, told the National Rivers and Harbors Congress that modern treatment facilities and prohibitions on dumping "should either be made compulsory or at least encouraged everywhere in the United States."

**Regulatory.** In its current regulatory program, the Corps has authority over work on structures in navigable waterways under the Rivers and Harbors Act of 1899, and over discharge of dredged or fill material under the Federal Water Pollution Control Act Amendments of 1972. This latter requirement applies to wetlands and other aquatic areas.

**DERP.** The Defense Environmental Restoration Program, first funded in 1983, enlarged the Corps' environmental work on installations. The armed services had already initiated efforts to remove hazardous materials from active installations. The new program added removing hazardous waste, unsafe buildings, ordnance, and other debris from active and former military sites. The Corps, already assisting the Environmental Protection Agency for toxic waste removal in the Superfund program, assumed DERP management in 1984 for all former military sites.

(This history is based on a longer essay by Dr. Martin Reuss, Office of History, and Dr. Charles Hendricks, Center of Military History.)



The Vehicle Assembly Building at Cape Kennedy is just one of the Corps' contributions to the space program. (Photo courtesy of the Office of History)



Early disasters, like the 1927 flood, led to the Corps' involvement in disaster relief. (Photo courtesy of the Office of History)



# Radio man keeps district on the net

Article by Jim Kluge  
Photo by Louie Reed  
Seattle District

Barry Premeaux literally goes to great heights to ensure Seattle District's radio net is operating at peak performance. He manages 212 pieces of equipment valued at more than \$621,000 which make up the district's microwave and VHF (very high frequency) communications system. Much of that equipment is on mountaintop microwave and VHF repeater towers at 16 different sites in Washington, Idaho, and Montana at elevations as high as 6,790 feet.

It would be more than an inconvenience to field and district office people to lose any of these vital communication links even for a little while. District emergency operations, as well as day-to-day project activities, rely on the radio net for instant voice communications. At some of the district's recreation sites, where cell phones might not work, the radio net might be the only communication link in case of an emergency.

Premeaux's job is to test, maintain, repair, and replace the district's communications equipment at these towers, and at the project offices. He is also accountable for the property.

Premeaux says he spends about half his time on the road, logging almost a thousand miles a week as he travels to some of the Pacific Northwest's remote and spectacular mountain regions. A tower site might be 25 to 30 miles beyond where the blacktop ends. At Mission Ridge, near Wenatchee,



Barry Premeaux (seated) and Bob Fielding are responsible for 212 pieces of communications equipment.

Wash., the road takes him to an elevation of 6,790 feet. That does *not* include the height of the tower he might have to climb when he gets there. The microwave and VHF towers range from 30 to 90 feet tall. Most of the tower sites are more than 2,500 feet in elevation, and nine of the summits with district radio net towers are above 4,500 feet.

Premeaux has been the district's radioman since 1982, so a drive up a cliff-hugging logging road to a communications tower is old hat for him.

But not so for his occasional first-time passenger. Mel Carr, Chief of the district's Internal Review Office, rode with Premeaux on one of his trips.

"It's a real eye-opener when you go up a narrow, winding road with Barry and at one point the outer wheel of his dual wheel rear axle pickup truck is slightly over the edge of a 1,000-foot drop," Carr said.

Premeaux says downed trees are his most common obstacle. As many as 13 trees have blocked his path on one trip. Usually under a foot in diam-

eter, the trees are only a temporary obstacle for Premeaux. He simply retrieves a bow saw from his truck and starts cutting.

In the winter, things can get dicey at these altitudes and long distances from civilization. Once on Idaho's Schweitzer Mountain, blowing snow wiped out traces of the path Premeaux followed in a snowcat to reach the VHF repeater tower. Markers were nearly impossible to locate in the 10-to-20-foot visibility. Employees of a nearby ski resort helped guide Premeaux back to the main trail down the mountain.

The Corps owns some of the towers. Others the district shares with agencies like the Coast Guard, Department of Transportation, Federal Aviation Administration (FAA), and the Federal Bureau of Investigation. Premeaux traveled to a tower site on snowmobile one time, hitch-hiking a ride with some FAA employees whose truck was also stopped by snow.

Premeaux doesn't work alone all the time. Bob Fielding, also a radioman with the district, is his right hand man and spends much of his time on the road to repeater tower sites.

Premeaux is also accountable for the electronic equipment and other property he manages. According to Carr, as the district's mission changes radio equipment is moved from one location to another throughout the three-state area, making accountability very difficult. But during a recent inventory of all 212 pieces of equipment under Premeaux's purview, only one was missing.

## Corps folks repair turbines

By George Hanley  
Kansas City District

Sometimes, if you want the job done right, you just have to do it yourself.

A dedication ceremony on Feb. 10 proved the truth of that old saying as a group of electric power users, marketers, and Kansas City District employees celebrated the end of the effort to repair the turbines at the Harry S. Truman Project.

The odyssey of Truman repair spans 14 years of contractor errors, quality control problems, and superhuman effort by district employees who stepped up to the plate to guarantee a quality reliable product.

The problems Truman powerplant has experienced are not unique to this type of plant. The Truman powerplant is a one-of-a-kind plant because it does not have speed increasers — a gearbox, in laymen's terms. Years ago, slant-axis turbines were proposed for a number of locations to increase the hydraulic efficiency or ease of pumping water to the upstream side for reuse during power generation. Places such as Truman Lake where the difference in upstream and downstream water levels was less were ideal for this type of plant, which also reduced the cost of excavation for the powerhouse.

But the slant-axis turbines were trouble from the beginning. Initially, in 1980-81, problems with keeping oil evenly distributed in the slant bearings plagued the project. Then after retrofitting the units, the

fishkill problem (common to all pumpback operations) prevented full-scale operation.

On Dec. 1-2, 1985, two units lost blade control because of an eyebolt failure, and until last Dec. 1, all six generator units have never been available for power generation.

And cavitation repairs were necessary throughout the turbine repair. Cavitation happens when a turbine turns too fast for water to flow around it properly, causing pockets of vapor to form, which erodes the steel.

After trying unsuccessfully to use contractors to repair the units, in 1991 Corps employees volunteered to do that work, saving taxpayers \$1.13 million. They finished the work on the last turbine last December.

Although the time needed for the repairs may seem long, working on a turbine unit requires 6-8 weeks for complete disassembly and 8-10 weeks for re-assembly, not including installation.

Other problems associated with the work are the sheer enormity of the size of the parts. Anyone with home power tools knows that getting planers set within two-thousandths of an inch is no small task, and it becomes tremendously difficult when the parts are forty inches in diameter.

Although repairs inside the turbines are complete, work continues to maintain unit availability. Maintenance work continues by Corps employees to keep the six generators operational. One is down at all times for maintenance while the other five operate.



Corps employees work on a runner assembly. (Photo courtesy of Kansas City District)



# Water safety

## New event takes message to wide audience in Omaha District

By Thomas O'Hara  
Omaha District

The calendar said April 1, but those attending a special event at Minot Air Force Base, N.D., and New Town, N.D. were no fools when it came to water safety. During the first weekend in April, Omaha District co-hosted the first Water Safety Days to educate the public about the dangers of work and play around the water. The district and the Air Force co-hosted the event April 1 at Minot's Base Field House. On April 2, the district and the Three Affiliated Tribes co-hosted the event at the Four Bears Casino in New Town.

Last fall, Omaha District Water Safety Committee analyzed the accident record along the mainstem projects and recognized a disproportionate number of incidents and fatalities involving Native Americans. Furthermore, they noted a large number of incidents involving military personnel in the Lake Sakakawea area.

In response, Col. Mark Tillotson, Omaha District Commander, charged the district to renew its efforts to reach the public with water safety messages. Water Safety Days met that challenge.

"The idea came about last October," said Joe Hall, lake manager for Garrison Project. "I got with Tony Jacobson (natural resource specialist) and George Wolf (operations manager) and together we came up with Water Safety Days to address all aspects of water safety."

The two-day event included more than a dozen booths that provided hands-on training on hypothermia, thin ice recognition, proper use/wear of personal flotation devices (PFDs), safe boating operations, drowning victim identification, and more. The main theme was "Reach, Throw, Don't Go!" — a motto to promote the safe way to assist a drowning victim.

"Time and again you read in the newspaper of a drowning tragedy that could have been avoided," said Keith Gordon, natural resource specialist for

Garrison Project. "One person after another went out to help someone, and instead of one victim you end up with five. We want to show how you can avoid dangerous situations, and also how to safely help a water victim without jeopardizing yourself."

One demonstration of these principles involved empty detergent bottles donated by Jamestown Hospital in Jamestown, N.D., and 50 to 75 feet of quarter-inch nylon rope to make a simple emergency lifesaver. Corps employees and their co-hosts added a "Reach, Throw, Don't Go" label, and gave out several hundred to get out this key water safety message.

The throw-bottle booth wasn't the only interactive exhibit. Most booths took a hands-on approach to get the visitors involved in the activities. Younger audience members received candy after understanding each booth's message, and enjoyed a water safety coloring contest.

One highlight was a PFD fashion show to demonstrate the variety of devices available, including their proper wear and use.

"Some of the newer floatation devices are very comfortable and look like hunting jackets," said Tex Hall, Chairman of the Three Affiliated Tribes in North Dakota. "We've come a long way. Using the life jackets, making them available, and educating our membership of the potential dangers of going out on the water without taking proper precautions is very important."

"I'm really pleased with the turnout, and with the involvement and partnership with the Corps of Engineers," Hall added. "It's really beyond all my expectations. We shouldn't stop here; we need to do these things every year. With the partnership of the Corps, we can continue to do this."

Local businesses donated dozens of lifejackets, adult- and child-sized, to give out as door prizes during the event.

"Anytime we have an opportunity to have fun and learn something in the



David Vader explains the use of a throw bottle. (Photo by Tom O'Hara)

process, that's a great event, particularly in a family environment," said Col. Dick Newton, Minot Base Commander, who attended with his daughter, Addy. "We get the little ones to think 'safety,' then they become adults who think 'safety.' Anytime we can make safety fun rather than a hassle, we're saving lives."

According to Minot AFB personnel who attended, it was time well spent.

"This is great," said Staff Sgt. Robert Bails, assigned to the Electronics Lab at the Space Wing at Minot. He brought his children Nicholas, Cierra, and Madisyn. "We do things around water quite a bit and not often do we get to concentrate on safety. You never get a chance to show them (the kids) all the things that can happen. Here they can see it, and learn what to do."

Newton said the base and the Corps have maintained a strong partnership.

"I've commanded Minot for two months, and I've already met three times with the Corps from Omaha, so that's a good sign," he said. "The Corps supports us from a number of angles — safety sessions like this, facility and infrastructure maintenance and development. It's not going to happen without the Corps on board. I think we have a very strong partnership."

Water Safety Days also provided recreation and park information.

"This is a remarkable idea," said popular outdoorsman Tony Dean, who held two seminars each day for the outdoor recreation crowd. "North and South Dakota may not be large in population but, per capita, boat ownership is high. Boating is new here, and many who jumped into the boating boom are probably not properly prepared."

"This can be some of the roughest water in the world, so emphasis on safety is what the doctor ordered," Dean continued. "It's amazing how many fisherman aren't aware what we are

required by law to have on a boat — life jackets, Coast Guard approved equipment, throwable cushions, fire extinguishers, you name it. I'm surprised how few anglers or boaters are aware of the rules of the road. We're blessed with some great resources here. The easiest way to enjoy them, for a long period of time, aside from taking care of the resources themselves, is to enjoy them safely."

The two-day event was so successful that Corps personnel are already planning for future events. "This is kind of a pilot program," said Hall. "We intend to do this again next year, perhaps in new communities around the project area."

The Water Safety Committee noted the positive results of the water safety days. "Without question this has been very successful," said Wayne Freed, outdoor recreation planner. "We reached more than 300 people in Minot and several hundred more in New Town. The effort that Joe and his staff have put into this is tremendous. The booths have all been well-prepared and well-thought-out, especially considering the quantity of booths."

"If you look at all the booths, there's something for everyone," Freed continued. "We didn't just target little kids; we went after adults, too. Now we've seen areas where we can improve. I think it's only going to get better."

Besides the Corps, Air Force, and Three Affiliated Tribes, other participants included North Dakota Game & Fish, U.S. Fish and Wildlife Service, Bureau of Indian Affairs, local dive teams and law enforcement, Trinity Hospital, and the Red Cross.

"Corps spouses and others donated their time as well," said Hall. "One thing that can't go unmentioned is the total support this effort has received throughout the district. No one said 'no' and that helped make this possible."



Brandi Schatz explains the use of ice-claws. (Photo by Bob Etzel)



# Flood mission goes to exotic land

By Liane Freedman  
Pittsburgh District

**A**frica.

It is a land of fascination and charm; a land of different peoples and cultures; a land of beauty, yet a land that has seen much sorrow.

Mark Philips, a hydraulic engineer in Pittsburgh District's Water Management Section, recently deployed to southern Africa in response to the devastating floods that took many lives and wreaked havoc there.

Philips was part of a team of six U.S. Army Corps of Engineers dam safety and water management experts that deployed March 6 to South Africa, Mozambique, Zambia, and Zimbabwe to support U.S. European Command's Joint Task Force Operation Atlas Response in humanitarian flood relief efforts.

When Philips returned to Pittsburgh March 26, family, friends, Corps team members, and the news media greeted him at the airport. Col. David Ridenour, District Engineer, honored Philips for his work and gave him a district coin.

## Mission

The Corps team visited three reservoirs (Cahora Bassa, Kariba, and Kafue) in Mozambique, Zimbabwe, and Zambia. They advised the Joint Task Force, the U.S. State Department, and host nation officials on predictive flooding analysis and modeling. They also assessed dam safety and the potential impact of flooding of various rates of water releases at the three hydroelectric dams.

"We went to see if the reservoirs were being operated in accordance with their design criteria, which they were," Philips said. "They had the right pool for the right time of year."

The reservoirs drainage basins that the team visited in the Zambezi River Basin cover an area three to six times the size of Pittsburgh District. In addition, the three dams were built to



Mark Philips faced the news media when he arrived home. (Photo courtesy of Pittsburgh District)

provide hydroelectric power, not flood control. Ninety-five percent of electricity in Africa is provided by hydropower.

Much of Philips' adventure involved sitting and waiting. Visas needed to be authorized from four different countries and it took time for processing. The team's plans changed from day-to-day depending on obtaining those visas.

"It was a long trip," said Phillips. "There was a lot of downtime; we sat in South Africa for a week. Due to the size of Africa, it was truly a logistical nightmare that required cooperation and coordination through four different countries."

"But it was definitely a rewarding and educational experience," Philips continued. "Our team was able to learn some things, and the people we talked to were able to learn some things. It became a very good information exchange."

To get to the reservoirs, the Corps team traveled both unpaved dirt roads and modern highways in four-wheel-drive trucks and sedans. It took them a day to get to a reservoir, a day to look at it, then another day to return to the city where they were staying.

The trip to Africa was an adventure

for Philips. "Anytime you get that far out of your element, it's an adventure," he said.

## Animals

The team stayed at a five-star hotel in Zimbabwe's capitol, Harare, and in hunting camps in South Africa where they were warned not to leave the fenced area after dark. They heard the roar of lions and saw the big cats feeding on impalas. They had to check their shoes each morning before putting them on because lizards crawled into their footgear at night. Monkeys and baboons were plentiful, as were warthogs and impalas. Philips also saw giraffes, white rhino, hippos, crocodiles, jackals, hyenas and countless birds and insects.

"Most parts that we saw of Africa were sparsely populated," said Philips. "It was very mountainous. Most of the people were very poor and lived off the land."

Most of the roads in the bush were hard traveling, but the speed limit on rural roads was about 80 miles an hour. The six-foot tall grass grows to the road's edge, so the team never knew what would bolt out onto the

road in front of them. Fuel was scarce, especially in Zimbabwe due to the country's poor economy.

## Security

As in most large cities, urban crime was ever-present. Security guards armed with automatic weapons were everywhere, including at ATMs. For the people who live in southern Africa, Philips said there is only wealth or poverty — no middle ground. A middle-class is almost non-existent, and unemployment is 70 percent.

"Just about every district employee, if they lived in Africa, would have a three- or four-bedroom house with a pool," said Philips. "The residence would be surrounded by concrete walls and an iron gate topped with barbed wire. They would have a maid, a gardener, and a security guard. The maid and gardener, and possibly the guard, would live on the property."

Philips said the cities that the team visited still show the scars of recent civil wars. Ruins of bombed-out buildings and burned-out cars dot the outskirts of some cities.

Unlike American cities, the modern skyscraper cities of Zimbabwe, Mozambique, Zambia, and South Africa do not lead into suburbs. Outside the city, concrete and glass quickly give way to thatched-roofed huts, and asphalt roads become dirt.

## Misconceptions

"It was very beautiful there," said Philips of southern Africa. "Because it was the end of the rainy season, vegetation was lush."

Philips said he had a lot of misconceptions about Africa before visiting the continent. He found a land composed of many separate nations with their own politics, economies, priorities, agendas, and problems.

"Africa is not like a continent of separate states like the U.S.," he said. "It is more like how the U.S. would interact with Mexico."



The Corps team found that Africa is still a land of wilderness and exotic animals. (Photos by Mark Philips)



# Corps man was prisoner in North Korea

By Larry Crump  
Kansas City District

When Steve Woelk joined the Navy in 1966 he didn't know he would become part of a dark chapter in Navy history, or nearly lose his life in the process. He was serving on the *USS Pueblo* when it the North Koreans captured it.

Today, Woelk is an electrical technician assigned to Kansas City District's Fort Leavenworth Area Office. On Feb. 28, he received two more medals to go along with other decorations he has received for his part in the highly charged international event.

The *USS Pueblo* was part of Operation Click Beetle, the code-name for electronic and radio intelligence gathering by small non-combatant naval ships that operated close to potential enemies. Woelk was an engineman, part of a crew of six officers, 75 enlisted men, and two civilians.

On Jan. 23, 1968, the North Koreans attacked and captured the *Pueblo*, the first time in more than 150 years that a U.S. ship had been hijacked by an enemy state.

"Several North Korean ships visited us before Jan. 23, but on that day they came prepared," recalled Woelk. The attack on the *Pueblo* included a submarine chaser, four torpedo boats, and two Russian-built MiG fighter planes. The *Pueblo* was armed only with two .50-caliber machine guns, both covered with tarps frozen under a layer of ice and inch thick. Individual weapons -- pistols, rifles, and Thompson submachine guns -- made up the rest of their armament.

The North Koreans sent several warnings to heave to and allow a boarding party to come aboard, but Cmdr. Lloyd Bucher, the *Pueblo's* captain, desperately wanted to destroy classified material and send out calls for help.

Woelk was ordered to help destroy classified material as two more attacks followed.

Several crewmen, including Woelk, were injured by the Korean gunfire.

"When smoke from the burning papers started to billow out of the hatches and portholes, a 57mm round was fired at the ship and penetrated the area where we were congregated," said Woelk. He was squatting in front of a safe when the round hit. "The force of the blast and shrapnel blew me over backwards," he said. "I felt a tremendous burning sensation and found myself unable to move from the waist down."

His best friend, Duane Hodges, was virtually blown in half and died before the North Koreans boarded. Two other crewman, including Bucher, received less serious wounds.

Following the ship's capture, everyone, including the wounded, was transported to a holding area near Pyongyang, North Korea's capitol city.

Since Woelk was unable to move from the waist down, two North Koreans "one at my feet and the other at



A North Korean propaganda photo shows Steve Woelk talking to a doctor in North Korea. (Photo courtesy of Steve Woelk)

my head, wrapped a plastic table cover around me and dragged me down the passageway through the hatches. I hadn't seen any of the crew for quite some time and could only speculate they had been tossed over the side of into the frigid water...and thought I was next!"

Woelk, along with the two other most seriously wounded, were thrown into a cell together. They were denied the help of the ship's corpsman (medic), and were assigned a fireman with only rudimentary knowledge of first aid. Bucher, in his book *Bucher: My Story*, recalls that Woelk received no medical attention for the first several days.

"The guards would come into our room wearing bandanas around their face, since the stench of rotting flesh and blood was unbearable," said Woelk. "Infection was setting in and becoming a big concern."

In her book *The Ship That Never Returned*, Elanor Van Buskirk Harris wrote, "Woelk was horribly wounded in the lower abdomen, with no hospitalization for days. He bled profusely and his roommates kept him alive with whatever they could find to stanch the flow. Eventually the stench from his festering wound became so overpowering, his 'nurses'...vomited in the corridor, inadvertently forcing the guards to do something."

The North Koreans carried Woelk out on a blood-soaked stretcher and operated on him without anesthesia.

"It was on the evening of our 10th day after capture," said Woelk. "I was taken to a room in the same building that appeared to be an examining room. Here I was placed on a metal examining table. My legs were spread, and my feet were bound and tied to the table so I would not be able to move."

"I can still recall the scissors cutting away flesh, and being sewn up with sutures that looked like kite string," Woelk continued. "The Korean doctors removed a small handful of shrapnel. 'The operation seemed to last an eternity, but probably didn't last more than 20 or 30 minutes. I was told later that my screams could



Steve Woelk today. (Photo by Larry Crump)

be heard throughout the building and many crewmembers thought one of us was being tortured."

Two weeks after capture Woelk was still not doing well, so the guards loaded him on a stretcher and carted him off to a North Korean hospital. The room, about 10x15 feet, had a wooden floor with quarter-inch spaces between the boards for dirt and grime to collect, paint cracking and peeling from the walls, and an occasional bedbug.

Woelk spent the next 44 days behind a locked door, and no one around gave any indication they could speak or understand English. "I was allowed cigarettes, matches, cultural propaganda, a deck of cards and a pitcher of water," Woelk said. "Each day I would mark off the days with a burnt match."

Woelk's medical treatment consisted of a doctor using forceps to shove a strip of gauze, saturated with some type of ointment, as far into the open wounds as it would go.

One day something round and black came out with the gauze that drew the attention of the doctor. "It appeared a bedbug had found refuge inside me where it took advantage of a warm place

to sleep," said Woelk. "But it didn't seem to be a big deal with the staff."

Shortly before he was to be reunited with his crew, one of Woelk's wounds healed over, trapping fluid under the skin. "It was getting very tender," Woelk said. He didn't want another surgery without anesthesia, but he nevertheless notified the doctor. "He took one look, reached for the scissors and *snip!* water came gushing out. It was back to the forceps and gauze!"

During Woelk's hospital stay, Bucher and the other crewmembers signed the first of two "confessions," admitting their "crime" of illegally entering Korean waters for spying and intelligence gathering. Having little choice, Woelk signed the document, too.

Woelk lost 55 pounds in captivity. "What I was fed wasn't much different than what I understand the rest of the crew was fed -- basically watered-down soup, rice, and bread. The worms, maggots, nails, hair, teeth, and anything else the North Koreans thought to be nutritional came later when I returned to the crew. What the crew did *not* get that I received occasionally was an apple and goats milk."

Once back with the crew, Woelk experienced another uncouth medical procedure.

"When I was young, I always had trouble with tonsil infections, and the problem persisted when I was a prisoner," Woelk said. The Koreans solved the problem, again without anesthesia. "They took this clamping-type instrument, put it around one tonsil, tied a string to the tonsil and *crunch!* it was out!" Then they repeated the same procedure with the other tonsil.

Woelk said the North Koreans inflicted beatings and many other forms of cruel punishment for several months. "We were expected to cower down to them in humility and walk with our heads down, chin on chest and not look them in the eye," said Woelk. "They would hit you in the head with a rifle-butt hard enough to knock you to the ground, and it wasn't unusual for a guard to walk up, point his AK-47 at your head and dry-fire it."

The beatings eventually ended, but during their captivity the crew started giving their guards the obscene gesture called "flipping the bird" -- the extended middle finger. A national magazine printed a photo of the group where two members flashed the "good luck sign," and the caption explained the meaning. When the North Koreans learned that the *Pueblo* crew had made fools of them in front of the entire world, the beatings resumed and continued until just before the crew's release on Dec. 23, 1968.

Woelk received a medical discharge from the Navy, plus two Purple Hearts and three Navy Commendation Medals. In 1990 he belatedly received the Prisoner of War Medal.

During the Feb. 28 ceremony at Fort Leavenworth, Kan., held at the Buffalo Soldiers Monument, Woelk also received the Combat Action Ribbon and the Armed Forces Expeditionary Medal.



# Around the Corps

## Military Engineer of the Year

Lt. Col. Larry McCallister, Area Engineer for Europe District Engineer Group, Turkey, is the Military Engineer of the Year. He is responsible for all Corps engineering activities in Turkey, Italy, and Spain. He was honored for providing construction and engineering management support that improved quality of life and combat readiness of all U.S. forces and their families, plus Department of Defense and Department of State agencies in the three nation area.



**Lt. Col. Larry McCallister is the Corps' Military Engineer of the Year. (Photo courtesy of Europe District)**

He provided rapid construction support for two NATO combat operations—Operation Northern Watch (Northern Iraq) and Operation Allied Force in former Yugoslavia. He also assisted the U.S. Air Force in Turkey with earthquake damage assessment and repair, and provided critical infrastructure and force protection improvements.

As Area Engineer and Commander of the U.S. Engineer Group in Turkey, he headed the Corps' rapid response team of technical engineers who support the 39th Fighter Wing at Incirlik Air Base, where the Engineer Group is stationed. Shortly after his arrival in July 1998, two earthquakes hit southern Turkey. Base family housing, the shopping complex, and power and utility systems were damaged. McCallister's team was honored with the Air Force Outstanding Unit Award for its quick structural analysis and construction support to repair the damage.

Two weeks after the quakes, a Turkish labor strike paralyzed nearly all contract operations on Incirlik Air Base. Under McCallister's leadership, the Corps kept contractors working on emergency repairs and projects critical to Air Force missions over the no-fly zone in Iraq.

In Albania, from April to August 1999, McCallister was Base Camp Engineer for U.S. forces in Albania supporting air strikes against Serbian military targets. Under his leadership, the Corps built a base camp for 6,200 soldiers with Apache helicopters. He oversaw four months of intense engineer activity—first building the base camp at Tirana Airport; then tearing it down and restoring the landscape as U.S. Forces moved to Kosovo to begin peacekeeping operations.

## Design Achievement Award

The National Endowment for the Arts recently gave a Design Award to a Corps project cleaning up groundwater contamination at the former Naval Ammunition Depot near Hastings, Neb. The Corps and its contractor was one of 335 designs submitted. Only 35 projects won the award given only once every four years.

The technologies used in the cleanup reduced the trichloroethylene (TCE) contamination from 5,000 parts per billion to below the drinking water standard of five parts per billion. At one of the eight contamination sources, the Corps implemented air-sparging, which injects air into the water table from a horizontal well. The air strips the TCB from the groundwater, and vacuum wells draw the vapors out of the soil. The vapors are processed through a carbon filter system to remove the contamination and release clean air.

A polishing technique using microorganisms

brought the TCE levels below the maximum contamination limit. Methane gas was fed into the sparged air to feed the growth of a natural microorganism which releases enzymes to break down the TCB into harmless byproducts.

## Marsh restoration

A groundbreaking ceremony at Scusset Beach State Reservation in Bourne and Sandwich, Mass., on April 10 launched one of the largest wetland restorations ever undertaken in New England. Scheduled for completion in 2001, the \$1.8 million, 50-acre Sagamore Marsh restoration project will restore tidal flow to the site, returning it to salt marsh and estuarine habitat.

The project is directed by New England District and the Massachusetts Executive Office of Environmental Affairs. Of the \$2 million cost, the federal government is contributing about \$1.5 million, with the remainder funded by Massachusetts Department of Environmental Management.

Tidal flushing of Sagamore Marsh was reduced in the mid-1930s when the Cape Cod Canal was widened and deepened. Accretion of material north of the jetty, plus disposal of dredged material in the marsh, contributed to the reduction of tidal flows. A 48-inch culvert was built in the mid-1930s at the south end of the marsh to drain runoff into the canal. The culvert was inadequate for sufficient tidal flushing to maintain the salt marsh, and the present level of tidal interchange supports about 12 acres of salt marsh and estuarine habitat.

The project will replace the existing 48-inch culvert with six-by-six-foot concrete box culverts, install electric sluice gates for primary flow control with manual backup, and deepen and widen the man-made channel extending 1,100 feet north into the marsh.

Northern Construction Service of Hingham, Mass., is doing the work.

## OCS Hall of Fame

Stephen Coakley, Deputy Chief of Staff for Resource Management, was inducted into the Officer Candidate School (OCS) Hall of Fame during ceremonies on April 7 at Fort Benning, Ga. Hall of Fame inductees are OCS graduates who distinguish themselves in military or civilian pursuits.

## Professional of the Year

Casey Kruse, Endangered Species Coordinator for Omaha District, received the Professional of the Year Award from the South Dakota Chapter of the Wildlife Society. Nell McPhillips, a wildlife biologist with the U.S. Fish & Wildlife Service in Pierre, S.D., nominated Kruse. "Mr. Kruse is an exemplary professional," said McPhillips. "He translated his wildlife biology expertise into natural resource benefits for the Missouri River."

Kruse initiated and completed major habitat projects for terns and plovers on the Missouri River when high river flows in 1995 and 1996 threatened to sweep away some 700 tern and plover eggs. Salvaging the eggs was a large-scale, difficult task. Kruse set up a tern and plover rearing facility, and developed protocol for rescuing, incubating, brooding, rearing, and releasing the birds. Kruse's success has far exceeded expectations.

"His attitude is one of sharing and cooperation with a great concern for the species," said McPhillips. "The knowledge gained through his efforts have been essential to recovery for these species and would have never been obtained if Mr. Kruse did not have the initiative to color outside the lines."

Kruse has also taken technological opportunities and translated them into resource benefits for the Missouri River. He has been instrumental in lead-

ing research efforts to model sandbar and island formation. Thanks in part to his efforts, the Corps is now better able to operate and manage the Missouri River for terns and plovers.

## Environmental Award

A biologist at the Engineer Research and Development Center's Environmental Laboratory has received the Walter T. Cox Award. Dr. H. Roger Hamilton, a supervisory biologist and Chief of the lab's Resource Management Branch, received the award from the George B. Hartzog Jr. Environmental Awards Program.

The Walter T. Cox Award is given for sustained achievement in public service providing inspirational leadership in policy formation affecting natural and cultural resources.

## Patriot's Day parade

New England District has strong historical ties to



**The New England District Ranger Color guard participated in the Patriot's Day Parade in Concord, Mass. (Photo courtesy of New England District)**

Massachusetts. To honor both the Corps' roots and those who fought in the Revolutionary War, the New England District Ranger Color Guard participated in Concord's Patriot's Day parade April 17.

The district has been invited to Patriot's Day activities since 1998. The event commemorates the actions of April 19 in Lexington and Concord which began the Revolutionary War.

The color guard accepted the Concord Millennium Medal on behalf of the district.

The medal was a gift from the town in appreciation for the district's participation. The silver medal also celebrates Concord's 365th anniversary.

## Biology award

Dr. H. Roger Hamilton, a supervisory biologist and Chief of the Environmental Laboratory's Resource Analysis Branch, recently received the prestigious Walter T. Cox Award. The award is given for sustained achievement in public service providing inspirational leadership in policy formation affecting natural and cultural resources.

## Contractor Safety Award

Toda, Aoki, and Yahagi Corporation has earned the 1999 U.S. Army Corps of Engineers Contractor Safety Award for their outstanding safety record in building Yokosuka Naval Base's Fleet Activities Center (FAC).

More than 555,500 man-hours went into building the five-story reinforced concrete facility with no time-loss injuries and no fatalities. The FAC supports in-port sailors with a multitude of services, including the Morale, Welfare, and Recreation Department, Navy Resale Activity, uniform shop, tailor shop, mini-mart, snack bar, book exchange, laundromat, telephone exchange, dry cleaning pickup, barber shop, pro shop, outdoor gear issue, and dental clinic. The building also houses two basketball courts, three racquetball courts, an air conditioned aerobics room, weight training room, saunas, and locker/showers."



# Corps' 'attic' filled with heirlooms

Article by Bernard Tate

Photo by F.T. Eyre  
Headquarters

What is the difference between an heirloom and junk?

The story behind it.

A pocketknife is just a cheap little blade, but to the family it's the knife granddad carried for years on the farm. The old kneading board is an eyesore unless you know it was grandma's, and still has petrified dough in its crevices. The faded old ornaments are junk until you know they have graced the family Christmas tree since the early 1900s.

The U.S. Army Corps of Engineers is a "family" with a 225-year history, and we have an "attic" packed with more than 10,000 heirlooms.

Most of what you see if you visit the Museum Storage Facility are tall tan cabinets, but bits of our history are scattered all around. A ship's wheel, propeller, and bell. A hulking black radio. A gleaming satellite studded with antennas and blue solar panels. Ship models. An old coffee cup and an ink pen. A model Saturn V moon rocket. Swords. Plumed hats. Guns. Shelves of old books. Racks of paintings and prints.

The ancient and the high-tech and the mundane and the what-is-it resting side-by-side. All with some part of the Corps' story to tell.

"Take that old radio, for example," said Clifton Chappell, the Corps of Engineers Curator. "That's a Westinghouse transmitter from the 1920s. During the 1927 flood, that was the Corps' only operational transmitter. So they preserved it in Cairo, Ill., and when we started talking about a museum for the Corps, they sent it to us."

And you look at it with new respect.

"It's just an ugly old radio until you know its story," Chappell continued. "An artifact brings history alive. That's why so many people relate to a museum. 'Yeah, I read about that in history class, but it wasn't much fun.' Then they go to a museum and see these items and read the explanation, and it adds a new dimension to history."

## Museum plans

The Corps does not have an actual museum yet, but "we've identified a potential building at Fort Belvoir, Va.," said Chappell. "We hope someday to get funding to renovate that building and turn it into the U.S. Army Corps of Engineers Museum."

Until then, the Corps' artifact collection is housed in the Museum Storage Facility, Bldg. 2585 at Humphreys Engineer Center near Fort Belvoir. The facility is not impressive from the outside, but it is the vital first step in preserving the Corps' history. There Chappell and Rod Gainer, a contract collections specialist, store and research artifacts.

## Tender loving care

"The first step is to put the artifacts in this facility, which is humidity and temperature controlled," Chappell said. "Roughly 50 to 60 percent of preserving artifacts is getting them out of the attic or basement and into the right facility. If you get them out of that environment, you automatically extend their life."

"We analyze them to make sure there are no infestations of bugs or mold or other things we don't want in this facility," Chappell continued. "Then we catalog them and attach a permanent number and never handle them again without gloves."

"And finally we put them in an acid-free environment — wrap them in tissue and pack them in boxes made from acid-free paper, and we put them in conservation storage cabinets that are dust- and light-free, which is about the best environment we can



Rod Gainer (left), a contract collections specialist, and Clifton Chappell, the Corps' curator, are dwarfed by just one corner of the artifact collection in the Museum Storage Facility.

give the item, in conjunction with this facility here."

Artifacts come to the Museum Storage Facility from a number of sources.

"We got our first load of artifacts during the transfer of the Engineer Museum from Fort Belvoir to Fort Leonard Wood, Mo., in 1989," Chappell said. "We got roughly half of that collection, about 1,500 items. The Engineer Museum focuses on the role of the combat engineer in history, while we concentrate on what the Corps has done to build the nation." So the Engineer Museum took many of the combat engineering artifacts, while the Corps got the civil works and nation-building items, plus some of the combat engineering artifacts as well.

"Another way we get artifacts is by donations from private individuals," said Chappell. "The largest part of the collection, about 7,000 items, came from a private donor. He was an engineer officer, and he had such an interest in the Corps' history that he went out and built a collection. He needed a home for it and, through negotiations with the first curator here, Mike Vice, he donated them to this museum."

## Favorites

It's not easy to get Chappell or Gainer to identify their favorite artifacts because they think in different terms from museum goers.

"When you work with artifacts as long as we have, it's difficult to say that you like one over another, because they all have a story," Chappell said. "To say you like this story better than that story wouldn't do justice to the whole story of the Corps."

But they relented from their idealism enough to list some of the more unusual items.

**Most interesting.** "I break it down by category," Gainer said. "Among the weapons, one of the most interesting is an 1840 engineer officer sword. The Corps of Engineers was very small at the time, only 30 or 40 officers, so regulation engineer swords from that period are extremely rare."

"Among the hats, we have quite possibly the only surviving Civil War kepi with its original engineer insignia," Gainer continued. "It belonged to a Private Hammond; we have his rifle as well."

"We also have a section of barbed wire that some engineer officer dragged back from the Western Front in World War I," Gainer said. "At the time it probably seemed mundane or silly, but now it's fascinating."

"One unique item is the wheel of the battleship *USS Maine*," said Chappell. The sinking of the *Maine* in Havana Harbor in 1898 started the Spanish-American war. "The Corps, of course, was in-

strumental in raising the *Maine* 1910 through 1912. The wheel came to the Corps at that time, although we're not sure how. We know that Col. William M. Black was in charge of the crew that raised the *Maine*. He probably got the wheel somehow, and it was displayed in the Chief of Engineers office from that time until it was transferred to the Engineer Museum in 1954."

**Largest.** "The wooden patterns to make new gears for navigation locks are quite large," said Chappell. "We had to turn some away because they wouldn't fit through our doors. We also have the colors of the only engineer battalion left in the regular Army after the Civil War, and it's six-and-a-half feet by six-and-a-half feet."

**Heaviest.** "On our loading dock we have a chunk of iron from the first iron-hulled vessel purchased by the Corps in the 1840s," Chappell said. "It's just a big four-foot-square piece of quarter-inch iron plate that shows some of the rivets. That may look strange to some people, but it's part of our history."

Since the museum has not been built, for the moment some artifacts (including the engineer battalion colors and the *USS Maine* wheel) are in the Historical Display Gallery at Corps Headquarters in Washington, D.C. When Headquarters moves to the General Accounting Office building in August, there will not be room for a gallery. There will be free-standing exhibit cases at each end and in the center of the main corridor of the floor the Corps occupies.

## The whole story

Both Chappell and Gainer emphasize that no matter how many artifacts they have, more are always welcome.

"We'd like for everybody in the Corps to know we have this artifact collection, and someday we will have a museum," said Chappell. "I'd like to emphasize that this is a museum for the *entire* Corps of Engineers. It's for everybody, and we would love to have input from the entire Corps."

"We have about 10,000 artifacts here, but there might be double that number out in the field," Chappell continued. "Our main goal is to tell the story of the *whole* Corps — military engineering and construction, civil works, the space program, research and development, disaster relief, support to the Army during deployments. Everything."

"So I want folks in the field to know that if they have an artifact they think might be interesting to our history, we'd love to talk to them about it," Chappell concluded.